

Workshop Manual - Supplement



LANCER

Evolution - IX

- Chassis
- Engine
- Wiring Diagrams
- Technical Information



MITSUBISHI

LANCER
EVOLUTION IX

SERVICE MANUAL

Supplement

'05-3

No.1036K12

GH-CT9A

LANCER

EVOLUTION IX

FOREWORD

This manual contains details of the main changes to the 2005 model Lancer Evolution IX. Only differences to the current Lancer Evolution VIII MR are included, so please use this manual in conjunction with the related manuals as listed on the following page.

Please read this manual carefully so that servicing can be done correctly and quickly, and vehicle performance maintained.

This manual is based on the current (March 2005) model. Please bear in mind that vehicle specifications may change and that future models may not be the same.

Please note that all the units shown in this manual follow the internationally recognized SI unit system, and that the used previously are not shown alongside the SI units.

(Nevertheless, please take care because units in reference documents may be shown in the units which were previously used).

Any opinions, requests or questions concerning this manual, should be written on the 'Servicing Comments Form' at the end of the manual, and sent to us by fax.

March 2005



MITSUBISHI MOTOR CORPORATION

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Related materials

Title	No.	Issue date	Title	No.	Issue date
New model manuals			Body edition service manual		
• Lancer Sedia	1036K30	2000/5	• Lancer Sedia	1036K50	2000/5
• Lancer Sedia	1036K31	2000/7	• Lancer Sedia (supplement)	1036K51	2000/7
• Lancer Evolution VII	1036K32	2001/1	• Lancer Evolution VII (supplement)	1036K52	2001/5
• Lancer Sedia	1036K33	2001/5	• Lancer Sedia (supplement)	1036K53	2001/10
• Lancer Sedia	1036K34	2001/5	• Lancer Evolution VII_MR (supplement)	1036K54	2004/2
• Lancer Evolution VII	1036K35	2002/1			
• Lancer Sedia	1036K36	2002/5			
• Lancer Evolution VII	1036K37	2003/1			
• Lancer	1036K38	2003/2			
• Lancer	1036K39	2003/12	Electrical wiring service manual		
• Lancer Evolution VII_MR	1036K40	2004/2	• Lancer Evolution IX	1036K82	2005/3
• Lancer*	1036K41	2004/3			
• Lancer	1036K42	2005/1			
• Lancer Evolution IX	1036K43	2005/3			
Service manuals			Engine service manual		
• Lancer Sedia	1036K00	2000/5	• 4G6 engine	1039G46	2001/1
• Lancer Sedia (supplement)	1036K01	2000/7	• 4G6 engine (supplement)	1039G63	2003/1
• Lancer Evolution VII (supplement)	1036K02	2001/1	• 4G6 engine (supplement)	1039G71	2003/3
• Lancer Sedia (supplement)	1036K03	2001/5			
• Lancer Sedia (supplement)	1036K04	2001/10			
• Lancer Evolution VII (supplement)	1036K05	2002/1	Transmission service manuals		
• Lancer Sedia (supplement)	1036K06	2002/5	• W5M51 manual transmission	1039M17	2001/1
• Lancer Evolution VII (supplement)	1036K07	2003/1	• W5M51 manual transmission (supplement)	1039M22	2003/1
• Lancer Sedia (supplement)	1036K08	2003/2	• WGMAA manual transmission	1039M23	2003/1
• Lancer Sedia (supplement)	1036K09	2003/12			
• Lancer Evolution VII MR	1036K10	2004/2			
• Lancer*	1036K41	2004/3			
• Lancer	1036K11	2005/1			

*Indicates where the new model manual was published with the service manual in a single volume.

WARNING REGARDING THE SERVICING OF VEHICLES FITTED WITH SRS AIR BAGS AND SEATBELTS WITH PRE-TENSIONERS

Warning

1. Improper servicing or maintenance of any SRS air bag or pre-tensioner fitted seatbelt component, or related parts, could cause serious injury through the SRS air bag or pre-tensioner fitted seatbelt being activated unintentionally or accidentally.
2. The SRS-ECU, the driver's side air bag module, the passenger side air bag module, the pre-tensioner fitted seatbelts and the clock spring, should be removed if there is a chance of them being affected by heat during painting work.
 - 93°C and above: the SRS-ECU, the driver's air bag module, the passenger's air bag module and the clock spring should be removed.
 - 90°C and above: the pre-tensioner fitted seatbelts should be removed.
3. Servicing and maintenance of any SRS air bag or pre-tensioner fitted seatbelt components, or related parts, must be performed by an authorized Mitsubishi dealer.
4. Servicing and maintenance of any SRS air bag or pre-tensioner fitted seatbelt components, or related parts, must only be undertaken after this service manual (specifically Section 52B-SRS air bags) has been carefully studied.

SECTION 00

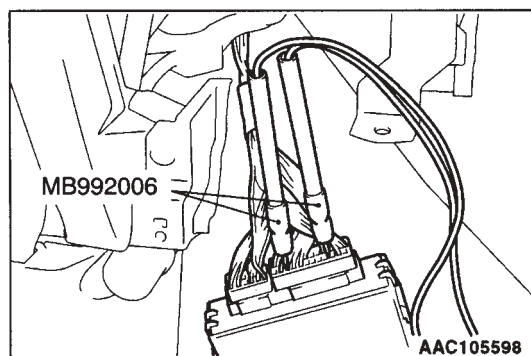
GENERAL

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Inspection guidelines and troubleshooting

With the introduction of new settings for the MB992006 (Extra Fine Probe) special tool, the guidelines for inspecting the connector have been changed. Other servicing guidelines remain unchanged.



Making an inspection with the connector attached (so the electrical circuit is complete) <non-waterproof connector>

The test bar should be inserted from the harness side. If the control unit or the connector is too small, and the test bar cannot be inserted, do not attempt to force it in. Instead, use the MB992006 (Extra Fine Probe) special tool.

Model line-up

Model	Version	05 model	Grade	Engine model	Transmission	Fuel system
GH-CT9A	SNDFZ	○	RS	4G63 (2000 DOHC 16 valve intercooler turbo)	W5M51 (4WD, 5M/T)	MPI
	SJDFZ	X	RS		W6MAA (4WD, 6M/T)	
	SNGFZ	●	GT		W5M51 (4WD, 5M/T)	
	SJGFZ	○	GSR		W6MAA (4WD, 6M/T)	

Note

● Indicates a new model, ○ indicates a special model, X indicates a discontinued model.

Relevant vehicle numbers

GH-CT9A: CT9A-0400001 ~

SECTION 11

ENGINE

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General

The following servicing guidelines have been prepared for vehicles which use the 4G63-MIVEC-T/C engine. Other servicing guidelines remain unchanged.

Servicing standards

Item		Standard level	Limit
Revolutions when idling r/min		800±50	-
Compression pressure kPa - r/min		1000-250	650-250
Cylinder head bolt (length of shaft) mm		-	99.4
Timing belt B tension (when checked)	Vibration cycle Hz	52 ~ 92	-
	Level of give mm	5 ~ 10	-
Timing belt B tension (when tuned)	Vibration cycle Hz	76 ~ 92	-
	Level of give mm	5 ~ 7	-
Timing belt B tension (when changed)	Vibration cycle Hz	76 ~ 92	-
	Level of give mm	5 ~ 7	-
Level of auto-tensioner rod projection mm		3.8 ~ 4.5	-

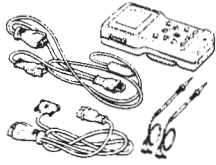
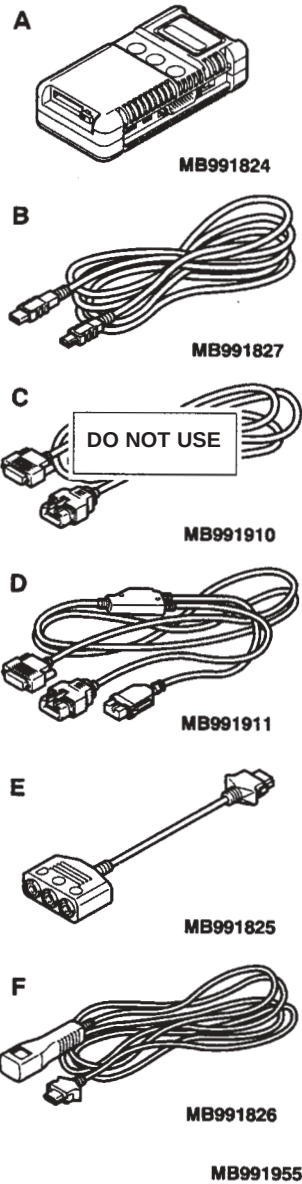
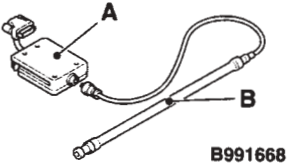
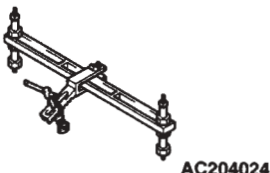
Sealants

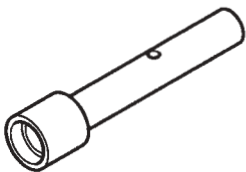
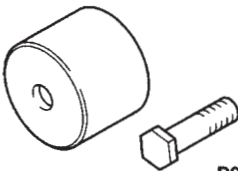
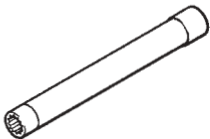
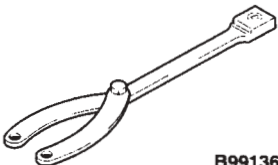
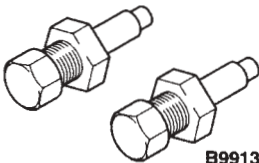
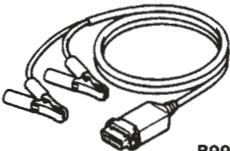
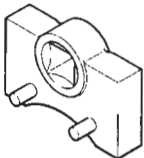
Location	Name
Rocker cover gasket	Semi-dry sealant: Three bond 1207D (MZ100168) (contents: 150g)
Cylinder head	
Camshaft position sensor support	Semi-dry sealant: Three bond 1207F (MZ100191) (contents: 150g)

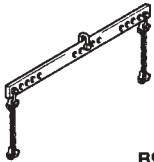
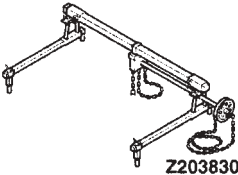
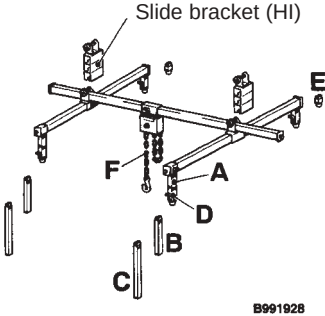
Note

The code inside the brackets () is the actual product number.

Special tools

Tool	Number	Name	Function
	MB991502	MUT-II Sub ASSY	Checking and adjusting the tension in timing belt B Note If a MUT-III main harness A is connected to a vehicle not fitted with CAN, there is a chance that a pulse signal will be entered in the simulated vehicle speed line, when the MUT-III is
 A: MB991824 B: MB991827 C: MB991910 DO NOT USE D: MB991911 E: MB991825 F: MB991826 MB991955	MB991955 A: MB991824 B: MB991827 C: MB991910 D: MB991911 E: MB991825 F: MB991826	MUT-III Sub ASSY A: Vehicle Communication Interface (VCI) B: USB cable C: MUT-III Main harness A (For vehicles fitted with CAN) D: MUT-III Main harness B (For vehicles not fitted with CAN) E: Adaptor F: Trigger harness	
 A B B991668	MB991668 A: MB991969 B: MB991670	Belt tension meter set A: Tension meter cartridge B: Mic ASSY	• Checking the tension in the drive belt. (Use in conjunction with VCI) • Checking the tension in the balancer timing belt. Adjusting (Use in conjunction with VCI)
 AC204024	MD998772	Valve spring compressor	Compression of the valve spring.

Tool	Number	Name	Function
	MD998737	Valve stem seal installer	Valve stem seal installation
 D998713	MD998713	Camshaft oil seal installer	Camshaft oil seal installation
 B991654	MB991654	Cylinder head bolt wrench	Cylinder head bolt removal, installation
 B991367	MB991367	Special spanner	Holding the crankshaft sprocket
 B991385	MB991385	Pins	
 B991704	MB991704	Battery harness	Checking and adjustment of the tension in the balancer timing belt (Use in conjunction with VCI or MUT-II)
 D998738	MD998738	Adjusting bolt	Holding the tensioner arm or the auto-tensioner adjuster
 D998767	MD998767	Tensioner pulley socket wrench	Adjusting the tension of the timing belt

Tool	Number	Name	Function
 B991454	MB991454	Engine hanger balancer	Holding the engine assembly while the transmission assembly is removed/installed
 Z203830	Recommended tools MZ203830 panzai or MZ203831 safe vehicle handling	Mechanical engine hanger	
 B991928	MB991928 A: MB991929 B: MB991930 C: MB991931 D: MB991932 E: MB991933 F: MB991934	Engine hanger A: joint (50) x2 B: joint (90) x2 C: joint (140) x2 D: Foot (standard) x4 E: Foot (short) x4 F: Chain and hook ASSY	

Engine tuning

1. Checking revolutions when the engine is idling

The standard revolutions for when the engine is idling have been changed. Other servicing guidelines remain unchanged.

Standard revolutions: 800 ± 50 r/min

2. Checking compression pressure

The standard for compression pressure and the limit for compression pressure have been changed. Other servicing guidelines remain unchanged.

Standard compression pressure: 1000 kPa – 250 r/min

Compression pressure limit: 650 kPa – 250r/min

Camshaft, valve stem seal

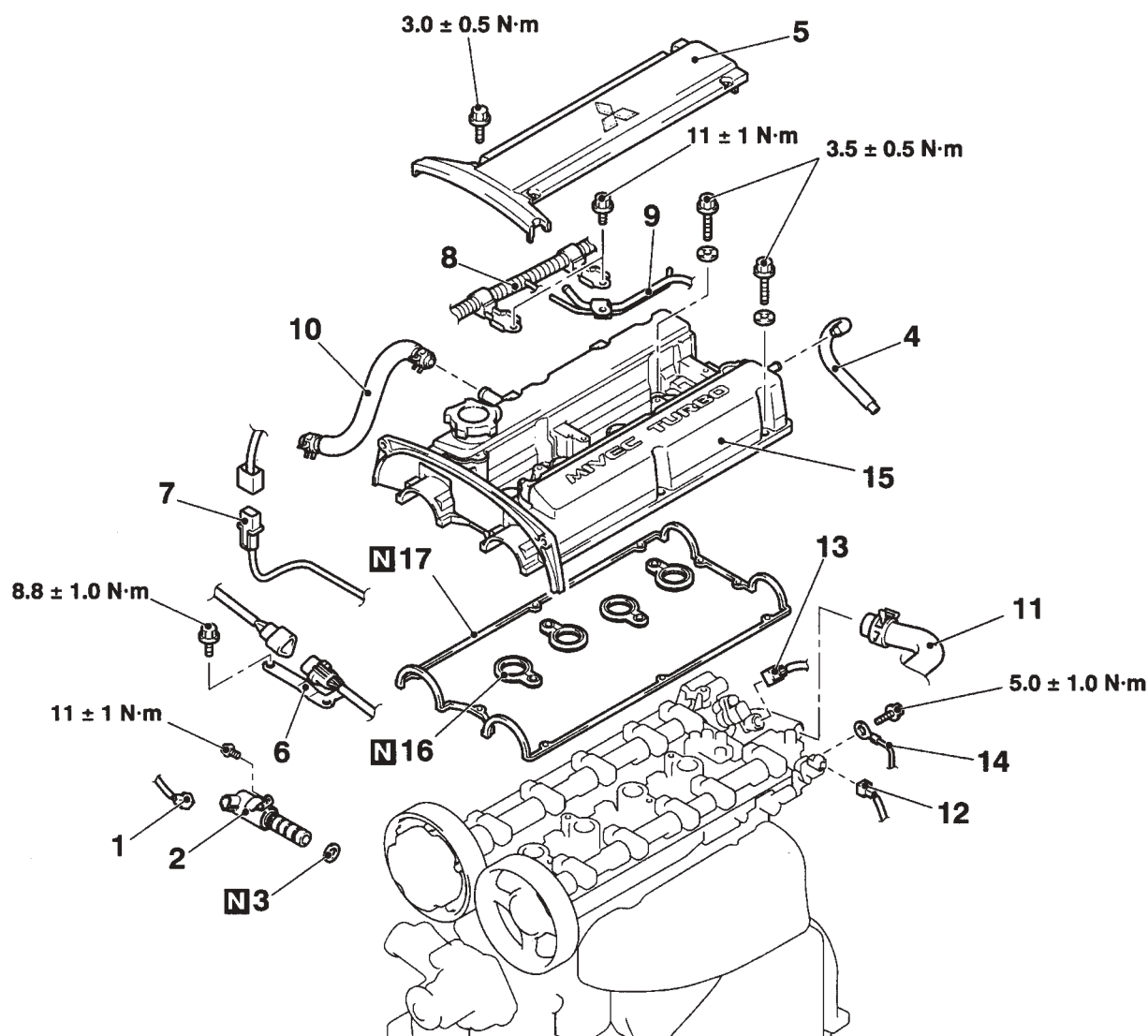
Removal and fitting

Caution

1. If Brembo brake callipers are being used take care that they are not scratched by other components or tools because there is a chance that the paint might peel off. In addition, if any brake fluid gets on the callipers, it should be wiped off immediately.
2. Parts marked with * should be removed and then fitted for each cylinder in turn.

Jobs to be completed before removal and after fitting

- Removal and refitting of the undercover (Ref Section 51: Front bumper)
- Checking the tension of the drive belt (only after fitting)
- Draining and refilling of the coolant
- Removal and refitting of the air duct
- Removal and refitting of air pipe C
- Removal and refitting of the timing belt (refer to P11-20)

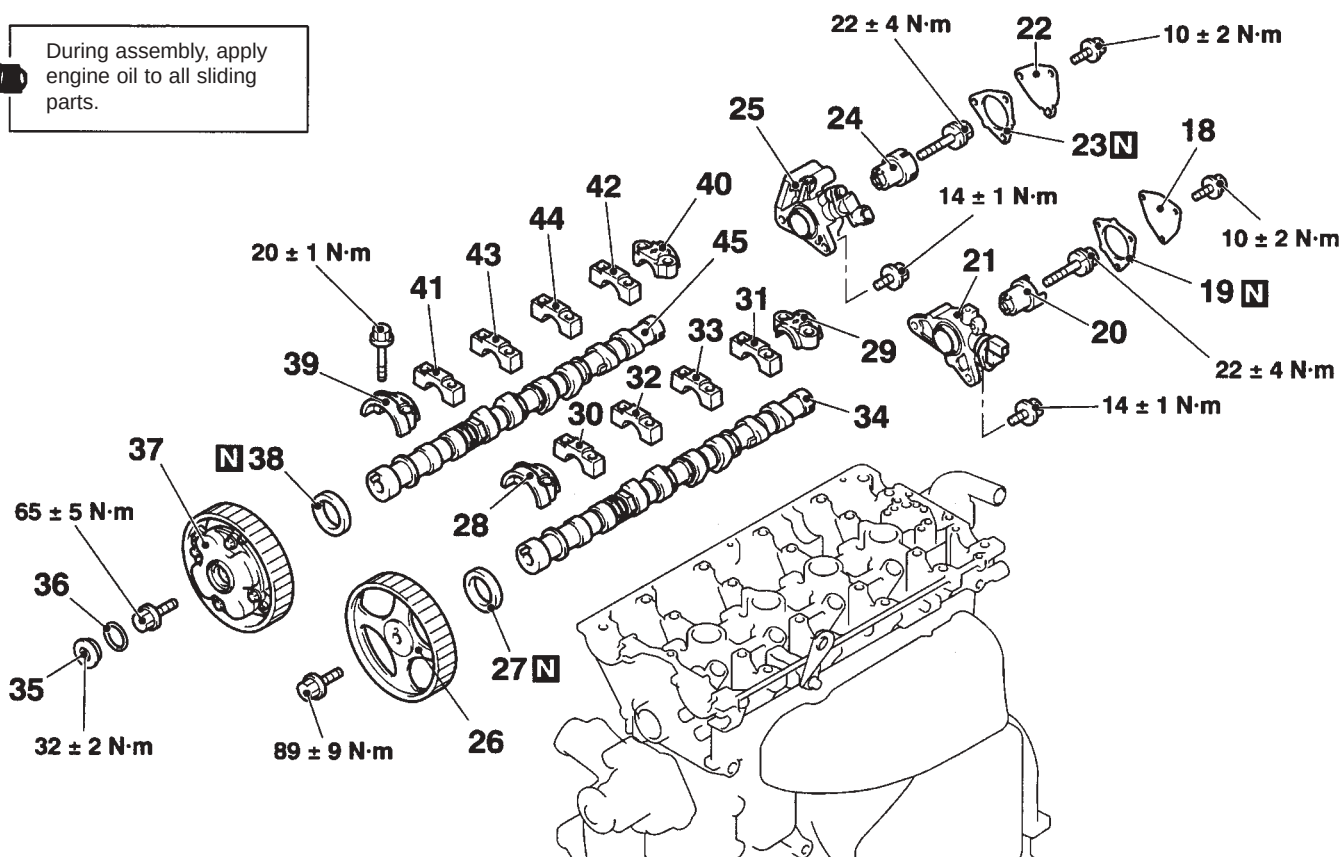


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Removal procedure

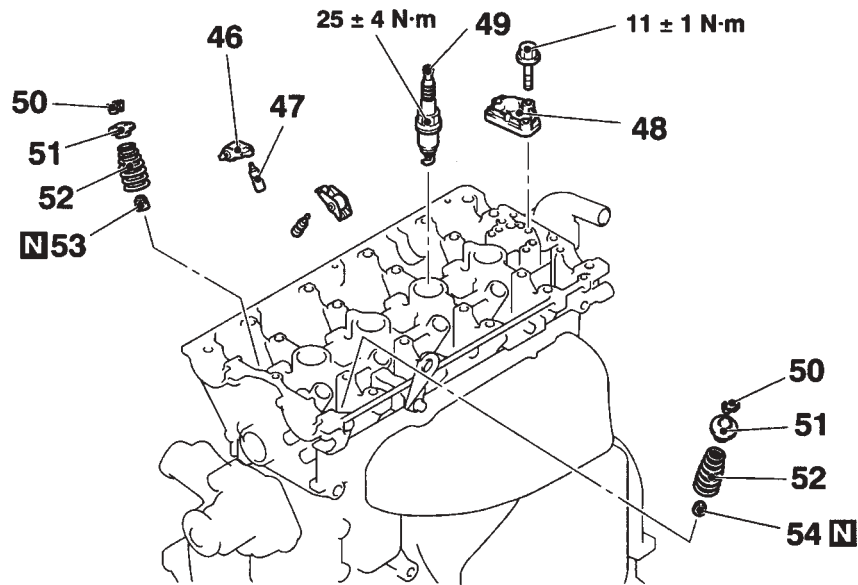
- | | |
|---|---|
| <p>▶ O ◀ 1. Oil feeder control valve connector</p> <p>▶ O ◀ 2. Oil feeder control valve</p> <p>▶ O ◀ 3. O-ring</p> <p>4. Breather hose</p> <p>• Secondary air control valve
(refer to Section 15-2: Secondary Air Control System)</p> <p>5. Centre cover</p> <p>• Ignition coil</p> <p>6. O₂ sensor connector</p> <p>7. Crank angle sensor connector</p> | <p>8. Connection of the control harness</p> <p>9. Vacuum hose</p> <p>10. PCV hose</p> <p>◀ A ▶ ▶ N ◀ 11. Connection of the radiator upper hose</p> <p>12. Camshaft position sensor connector (exhaust side)</p> <p>13. Camshaft position sensor connector (inlet side)</p> <p>14. Connection of the earth cable</p> <p>▶ M ◀ 15. Rocker cover ASSY</p> <p>16. Spark plug hole gasket</p> <p>17. Rocker cover gasket</p> |
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 During assembly, apply engine oil to all sliding parts.



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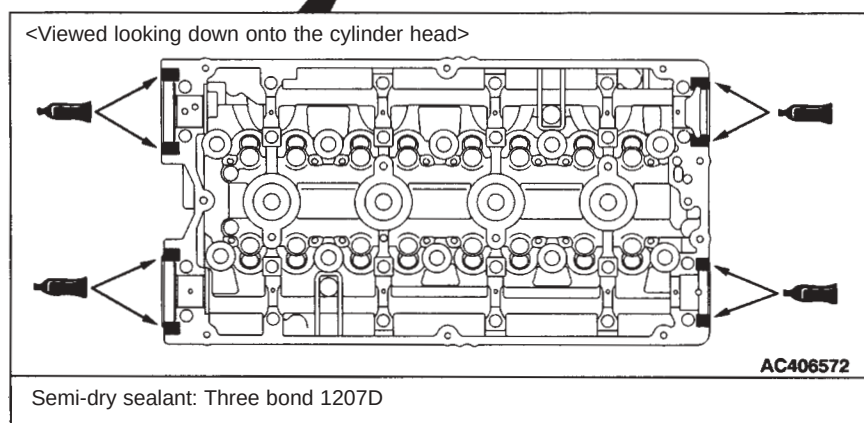
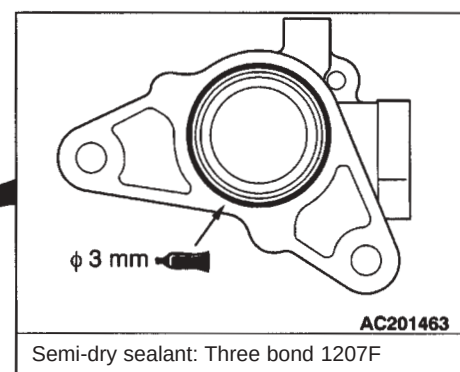
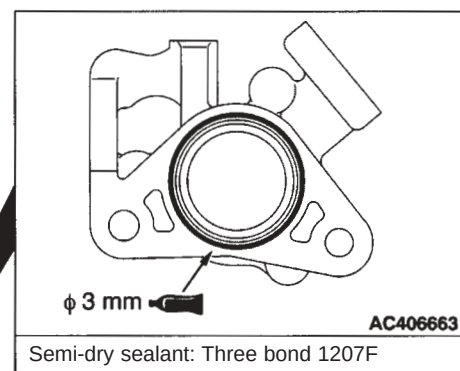
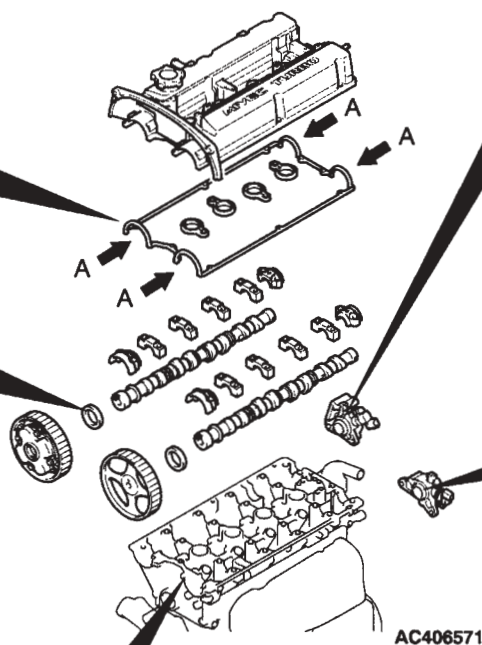
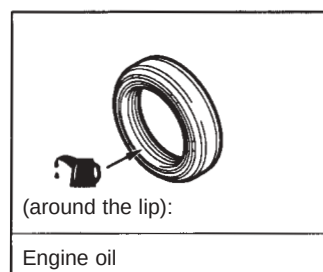
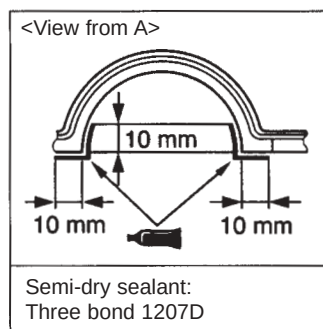
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| 18. Camshaft position sensor support cover | ▶ F ◀ 30. Camshaft bearing cap No. 2 |
| 19. Camshaft position sensor support cover gasket | ▶ F ◀ 31. Camshaft bearing cap No. 5 |
| ▶ L ◀ 20. Camshaft position sensing cylinder (exhaust side) | ▶ F ◀ 32. Camshaft bearing cap No. 3 |
| ▶ J ◀ 21. Camshaft position sensor support | ▶ F ◀ 33. Camshaft bearing cap No. 4 |
| 22. Camshaft position sensor support cover | ▶ E ◀ 34. Exhaust camshaft |
| 23. Camshaft position sensor support cover gasket | 35. Camshaft sprocket cap |
| ▶ K ◀ 24. Camshaft position sensing cylinder (inlet side) | 36. Washer |
| ▶ J ◀ 25. Camshaft position sensor support | ◀ B ▶ ▶ H ◀ 37. Camshaft sprocket (inlet side) |
| ◀ B ▶ ▶ I ◀ 26. Camshaft sprocket (exhaust side) | ▶ G ◀ 38. Camshaft oil seal |
| ▶ G ◀ 27. Camshaft oil seal | ▶ F ◀ 39. Camshaft bearing cap front |
| ▶ F ◀ 28. Camshaft bearing cap front | ▶ F ◀ 40. Camshaft bearing cap rear right |
| ▶ F ◀ 29. Camshaft bearing cap rear left | ▶ F ◀ 41. Camshaft bearing cap No. 2 |
| | ▶ F ◀ 42. Camshaft bearing cap No. 5 |
| | ▶ F ◀ 43. Camshaft bearing cap No. 3 |
| | ▶ F ◀ 44. Camshaft bearing cap No. 4 |
| | ▶ E ◀ 45. Inlet camshaft |

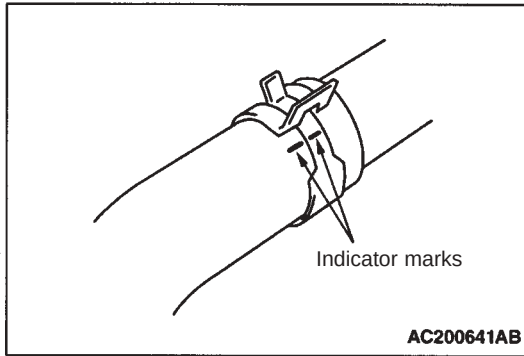


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| 46. Rocker arm | 51. Valve spring retainer |
| ► D ◀ 47. Rush adjuster | ► B ◀ 52. Valve spring |
| 48. Oil delivery body | ► A ◀ 53. Inlet valve stem seal |
| 49. Spark plug | ► A ◀ 54. Exhaust valve stem seal |
| ◀ C ▶ ► C ◀ 50. Valve spring retainer lock | |

Locations for the application of lubricant and seals

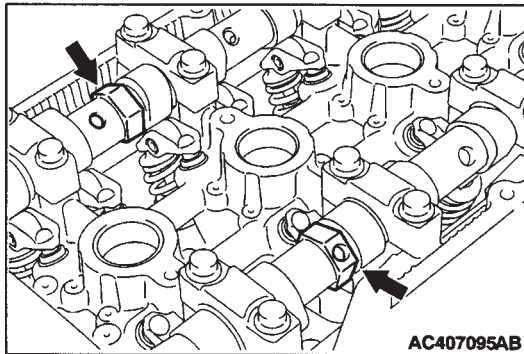




Removal guidelines

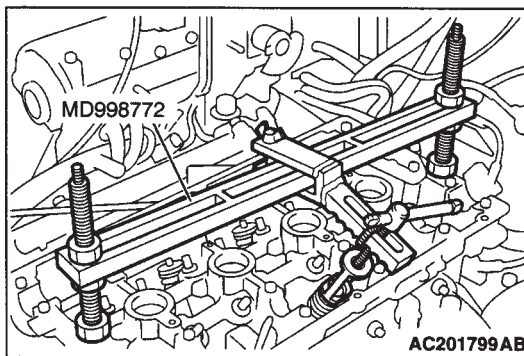
◀ A ▶ Detaching the radiator upper hose

Align the indicator marks on the radiator upper hose and the hose clamp, and then detach the radiator upper hose.



◀ B ▶ Removing the camshaft sprockets

Grip the hexagonal part of the camshaft with a wrench, loosen the mounting bolt, and remove the camshaft sprocket.

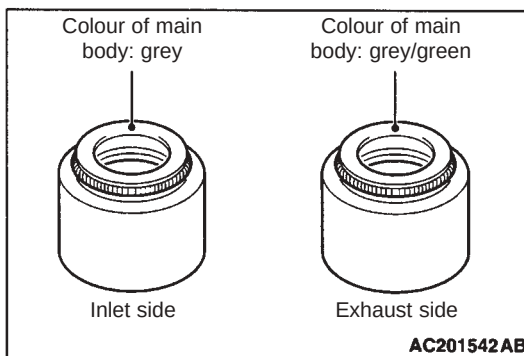


◀ C ▶ Removing the valve spring retainer lock

Compress the valve spring using the special tool for compressing valve springs (MD998772), and remove the valve spring retainer lock.

Caution

When removing the valve spring retainer lock, each cylinder piston should be in the top dead centre position. If pistons are not in the top dead centre position, valves could fall into the cylinders.



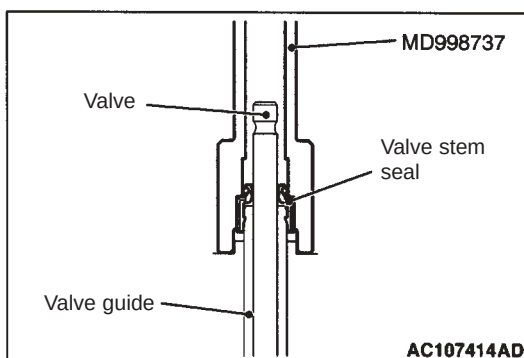
Fitting guidelines

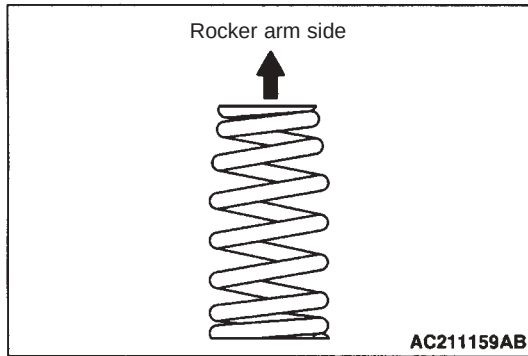
▶ A ◀ Fitting the exhaust valve stem seals and the inlet valve stem seals

1. Inlet valve stem seals and exhaust valve stem seals can be distinguished by checking the colour of the rubber parts.
2. Apply a small quantity of engine oil to the valve stem seals.
3. Place the valve stem component into the guides, and then insert a new valve stem seal into the valve stem guide by using the special tool for installing valve stem seals.

Caution

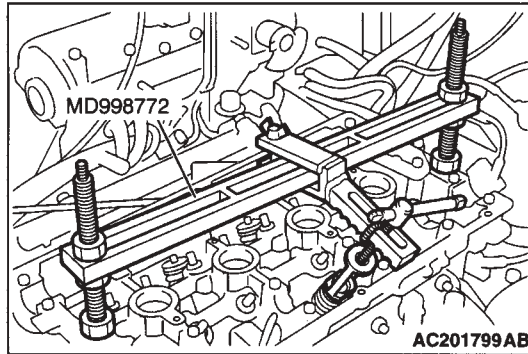
- (1) Valve stem seals cannot be re-used.
- (2) Please use the special tool for installing valve stem seals (MD998737) because oil could leak if the valve stem seals are not fitted correctly.





► B ◀ Fitting the valve spring

Fit the valve spring so that the end of the valve spring which has the smaller radius is on the rocker arm side.



► C ◀ Fitting the valve spring retainer lock

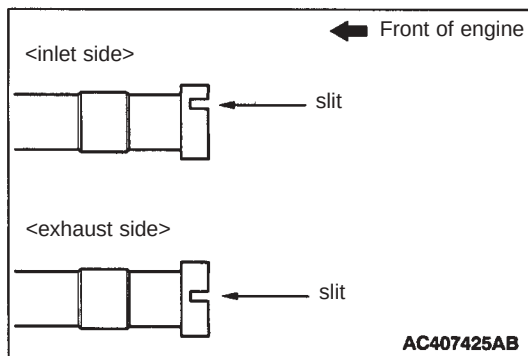
In the same way as when the valve spring retainer lock was removed, compress the valve spring using the special tool for compressing valve springs (MD998772), and fit the valve spring retainer lock.

► D ◀ Fitting the rush adjuster

Caution

If a rush adjuster is being reused, it must be washed and inspected before fitting.

(Ref: Engine Service Manual)

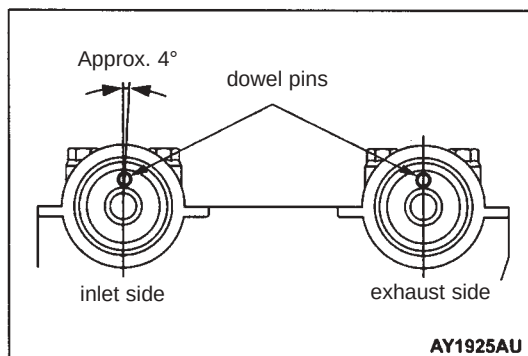


► E ◀ Fitting the camshaft

1. Remove any sealant from the cylinder head.
2. Apply engine oil to the camshaft cams and journals.
3. Fit the camshaft to the cylinder head.

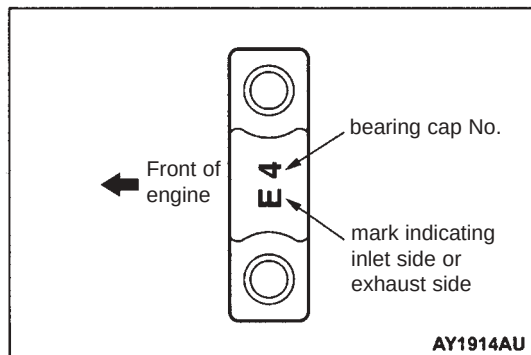
Caution

Ensure that the inlet and exhaust sides are not the wrong way round.



► F ◀ Fitting the camshaft bearing cap No.4, the camshaft bearing cap No.3, the camshaft bearing cap No.5, the camshaft bearing cap No.2, the rear camshaft bearing cap, and the front camshaft bearing cap

1. Set the camshaft dowel pins in the position shown in the diagram.



- Because camshaft bearing caps Nos. 2~5 are the same shape, check the identification marks on them so that the bearing cap number and the inlet and exhaust sides are not mistaken. Then fit them in the direction shown in the diagram.

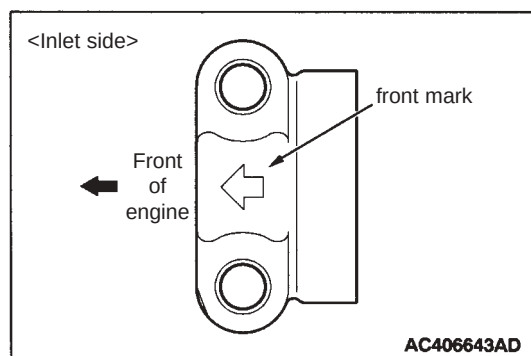
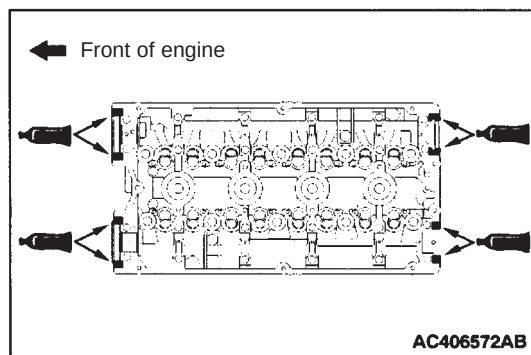
Identification marks (stamped on the front bearing cap, and on bearing cap Nos. 2~5).

I: inlet side

E: exhaust side

- Apply sealant at the 8 places shown in the diagram of the top view of the cylinder head.

Semi-dry sealant: Three bond 1207D



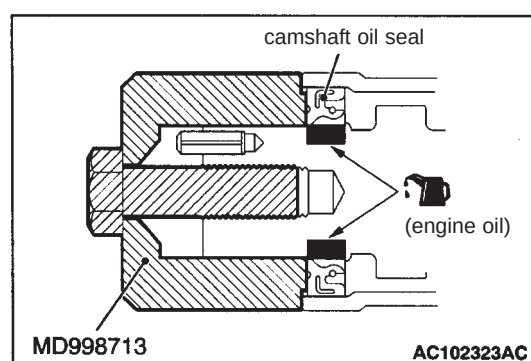
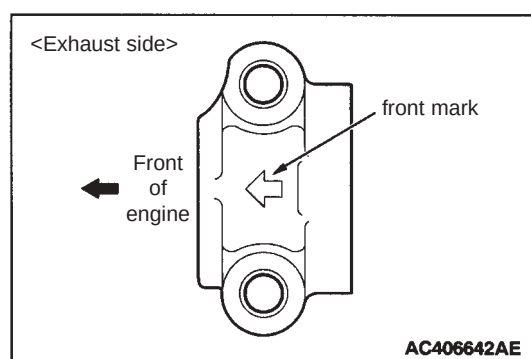
- Fit the rear camshaft bearing cap in the direction indicated by the front mark.
- In just the same way as for bearing caps Nos. 2~5, check the identification marks on the front camshaft bearing cap so that the exhaust side and the inlet side are not mistaken.
- Tighten the bearing cap mounting bolts gradually, 2~3 turns at a time, to the specified torque.

Tightening torque: $20 \pm 1 \text{ N}\cdot\text{m}$

- Check that the rocker arm has been fitted correctly.

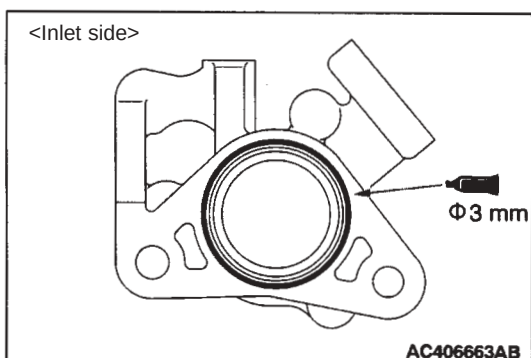
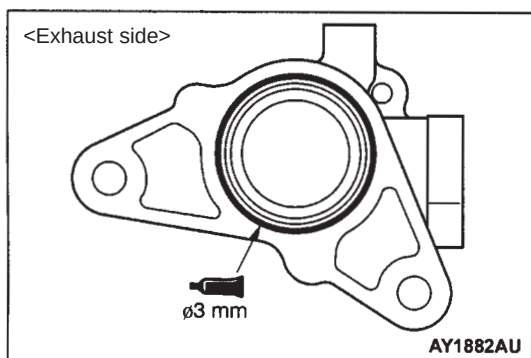
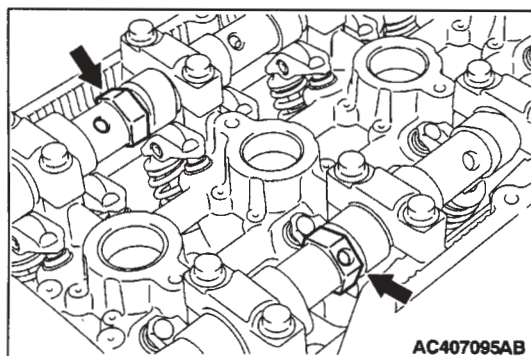
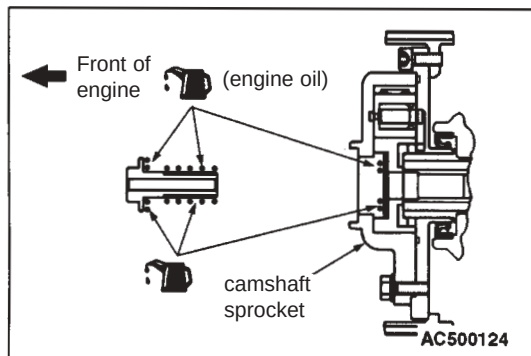
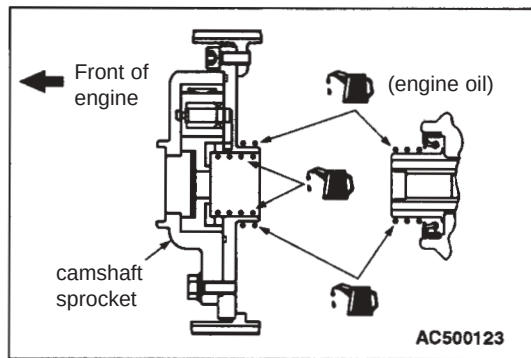
Note

Completely wipe away any sealant that has been squeezed out.



► G ◀ Fitting the camshaft oil seal

- Apply engine oil around the entire circumference of the oil seal lip.
- Insert the oil seal using the special tool for installing the camshaft oil seal (MD998713), as shown in the diagram.



► H ◀ Fitting the camshaft sprocket (inlet side)

1. Apply engine oil to the edges of the camshaft, and to the parts of the camshaft sprocket which will make contact with the camshaft.
2. Match up the camshaft dowel pins with the dowel pin holes in the camshaft sprocket, and fit the camshaft into the camshaft sprocket.
3. Hold the hexagonal part of the camshaft with a wrench, and check that the camshaft sprocket cannot be twisted.
Note
This operation is necessary because it is impossible to check by looking whether the camshaft dowel pins are inserted into the dowel pin holes in the camshaft sprocket.
4. Apply engine oil to the screw thread and the underside of the camshaft sprocket mounting bolt, and in the same way as when the camshaft sprocket was removed, hold the camshaft in place using a wrench and tighten the bolt to the specified torque.

Tightening torque: $65 \pm 5 \text{ N}\cdot\text{m}$

► I ◀ Fitting the camshaft sprocket (exhaust side)

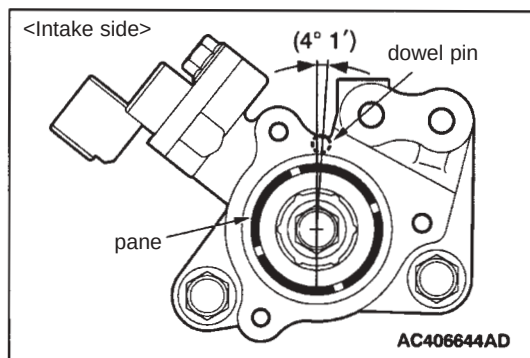
In the same way as when the camshaft sprocket was removed, hold the hexagonal part of the camshaft with a wrench and tighten the bolt to the specified torque.

Tightening torque: $89 \pm 9 \text{ N}\cdot\text{m}$

► J ◀ Fitting the camshaft position sensor support

1. Remove any sealant from the camshaft position sensor support.
2. As shown in the diagram, apply sealant to the flange of the camshaft position sensor support, and then fit it to the cylinder head.
Semi-dry sealant: Three bond 1207F
3. Tighten the mounting bolts for the camshaft position sensor support to the specified torque.

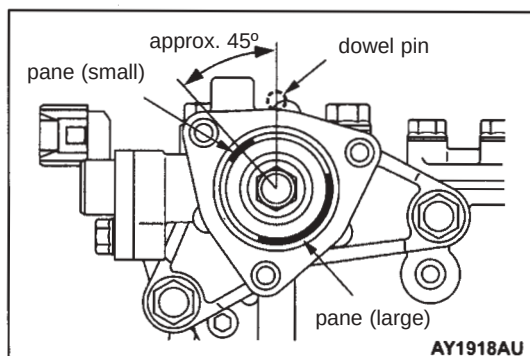
Tightening torque: $14 \pm 1 \text{ N}\cdot\text{m}$



► K ◀ Fitting the camshaft position sensing cylinder (inlet side)

1. Set the inlet camshaft dowel pin in the position shown in the diagram (No.1 cylinder compression top dead centre).
2. Tighten the mounting bolts for the camshaft position sensing cylinder to the specified torque.

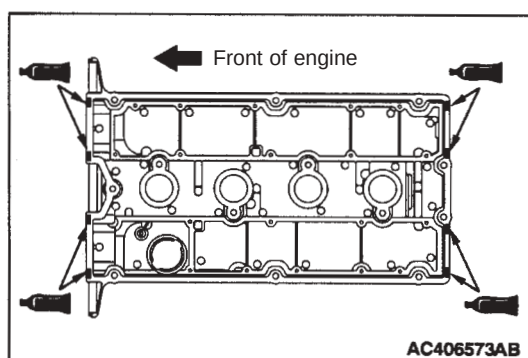
Tightening torque: 22 ± 4 N·m



► L ◀ Fitting the camshaft position sensing cylinder (exhaust side)

1. Set the exhaust camshaft dowel pin in the position shown in the diagram (No.1 cylinder compression top dead centre).
Note
Under pressure from the exhaust valve spring, it will turn slightly in an anti-clockwise direction.
2. As shown in the diagram, fit the pane (small) of the camshaft position sensing cylinder (exhaust side) so that it is in a position approximately 45° to the exhaust camshaft dowel pin.
3. Tighten the mounting bolts for the camshaft position sensing cylinder to the specified torque.

Tightening torque: 22 ± 4 N·m

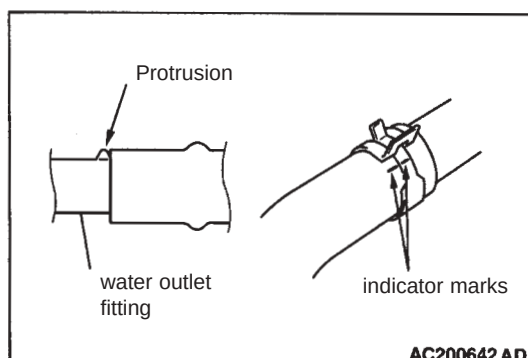


► M ◀ Fitting the locker cover assembly

1. Apply sealant to the 8 places on the rocker cover gasket as shown in the diagram.

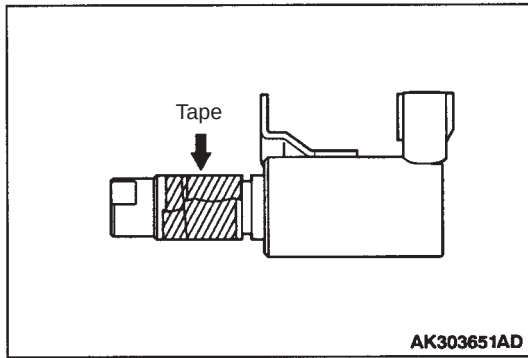
Semi-dry sealant: Three bond 1207D

2. Fit the rocker cover assembly onto the cylinder head.



► N ◀ Connecting the radiator upper hose

1. Insert the radiator upper hose as far as the protrusion on the water outlet fitting.
2. Match up the indicator marks on the radiator upper hose and the hose clamp, in order to fit the radiator upper hose.

**▶ O ◀ Fitting the O-ring/oil feeder control valve****Caution**

1. Do not re-use O-rings.
2. When fitting O-rings, first wind some non-adhesive tape (seal tape etc) around the oil channel of the oil feeder control valve, in order to prevent damage to the O-ring. If the O-ring touches the oil it could start an oil leak.
1. Apply engine oil to the O-ring on the oil feeder control valve.
2. Fit the oil feeder control valve to the cylinder head.
3. Tighten the mounting bolts for the oil feeder control valve to the specified torque.

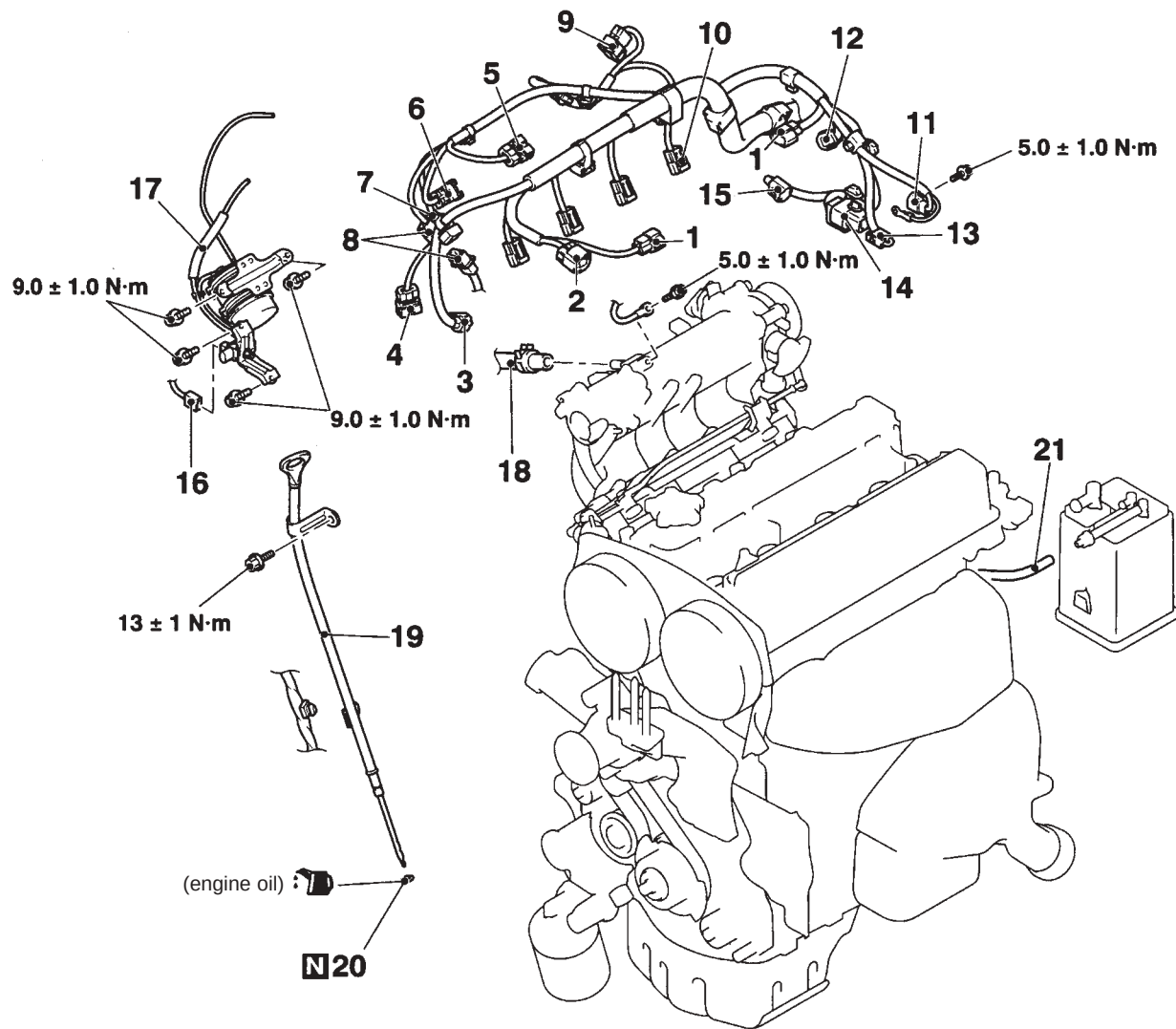
Tightening torque: 11 ± 1 N•m

Cylinder head gasket

Removal and fitting

Jobs to be completed before removal and after fitting

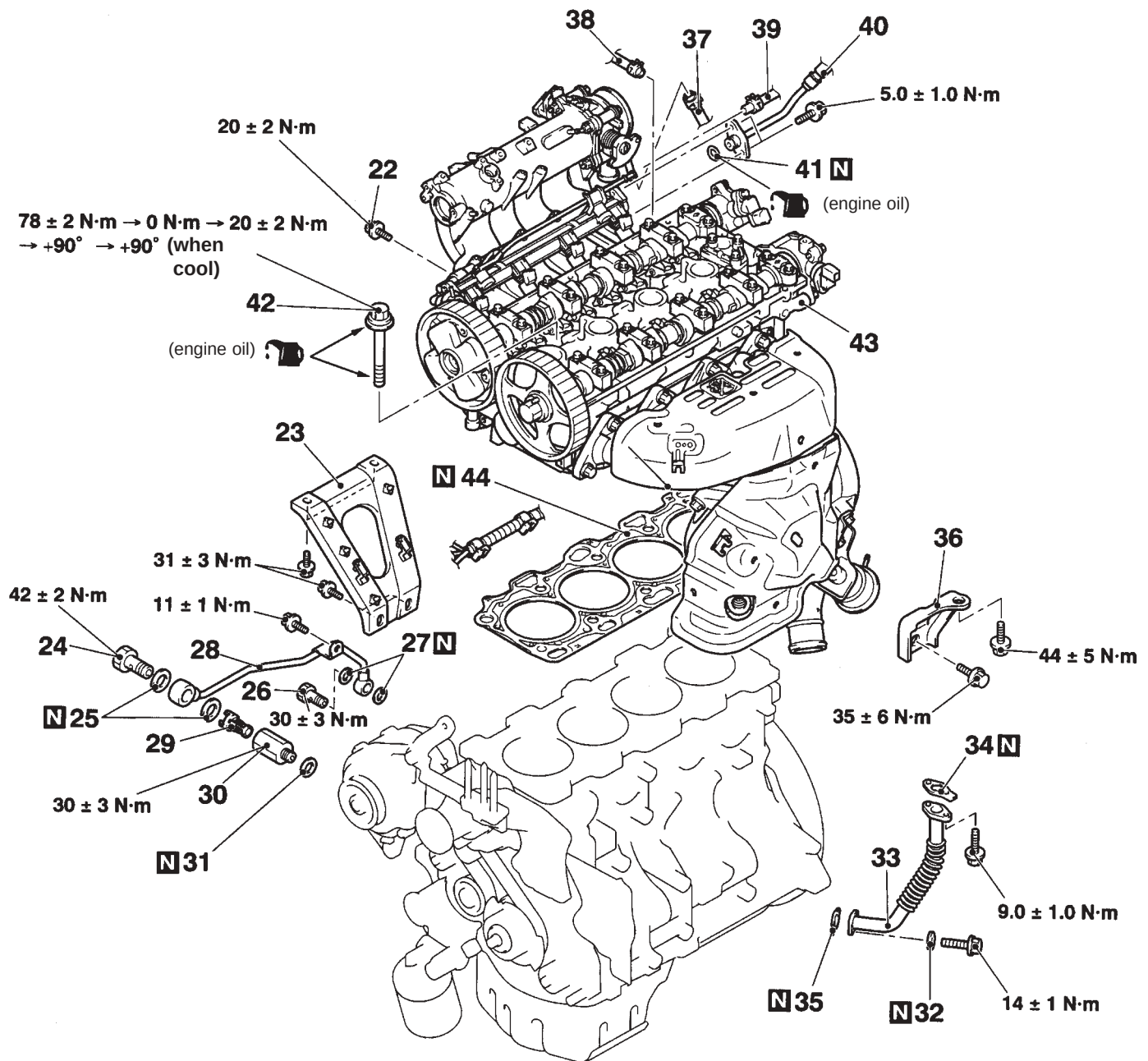
- Measures to prevent fuel leaking. <Only before removal>
- Check for fuel dripping. <Only after fitting>
- Removal and refitting of the strut tower bar.
- Removal and refitting of the valence. (Ref Section 51: Front bumper)
- Check the tension of the drive belt. <Only after fitting>
- Adjustment of the axle letter cable. <Only after fitting>
- Draining and replacing the engine oil.
- Draining and replacing the coolant.
- Removal and refitting of the air cleaner.
- Removal and refitting of air pipe C.
- Removal and refitting of the battery and the battery tray.
- Removal and refitting of the centre cover. (Ref P11-5)
- Removal and refitting of the axle letter cable.
- Removal and refitting of the radiator.
- Removal and refitting of the front exhaust pipe.
- Removal and refitting of the timing belt. (Ref P11-20)



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Removal procedure

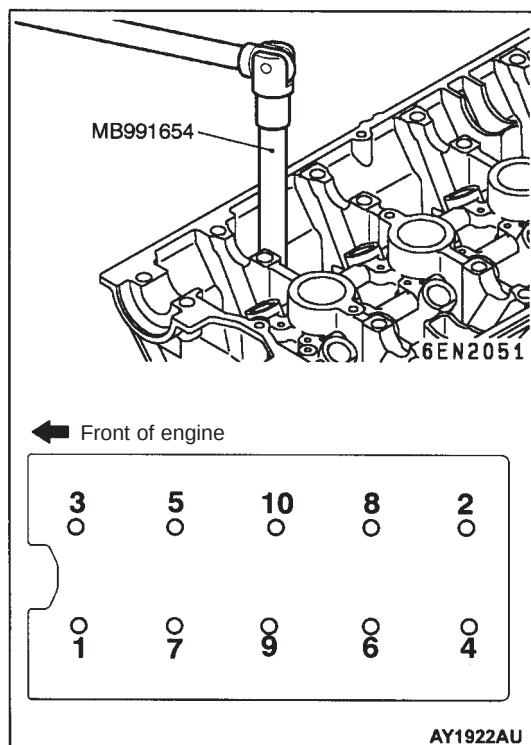
1. Ignition coil connector
2. O₂ sensor connector
3. Oil feeder control valve connector
4. Crank angle sensor connector
5. Manifold absolute pressure sensor connector
6. Fuel pressure solenoid valve connector
7. Knock sensor connector
8. Purge control solenoid valve connector
9. Throttle position sensor connector
10. Injector connector
11. Exhaust camshaft position sensor connector
12. Inlet camshaft position sensor connector
13. Water temperature gauge unit connector
14. Joint control harness and transmission harness
15. Water temperature sensor connector
16. Secondary air control solenoid valve connector
17. Vacuum tank, solenoid valve, vacuum pipe and hose assembly
18. Brake booster vacuum hose connection
19. Oil level gauge and guide assembly
20. O-ring
21. Purge hose connection



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22. Alternator bracket connection
 23. Inlet manifold stay
 ▶ E ◀ 24. Eye bolt
 25. Gasket
 26. Eye bolt
 27. Gasket
 28. Oil feeder control valve pipe
 29. Filter
 30. Oil pipe joint
 31. Gasket
 32. Oil return pipe gasket
 33. Oil return pipe
 34. Oil return pipe gasket

- ▶ D ◀ 35. Oil return pipe gasket
 36. Exhaust fitting bracket
 • Water outlet fitting and thermostat case assembly (Refer to Section 14: Water hose pipe)
 37. Water hose connection
 38. Heater hose connection
 39. Fuel return hose connection
 ▶ C ◀ 40. Fuel high pressure hose connection
 ▶ C ◀ 41. O-ring
 ▶ A ▶ ▶ B ◀ 42. Cylinder head bolt
 43. Cylinder head assembly
 ▶ A ◀ 44. Cylinder head gasket

**Removal guidelines****▶ A ◀ Removing the cylinder head bolts**

Use the special wrench for cylinder head bolts (MB991654) to turn the bolts 2~3 times in order to loosen them, before removing them in the numerical order as shown in the diagram.

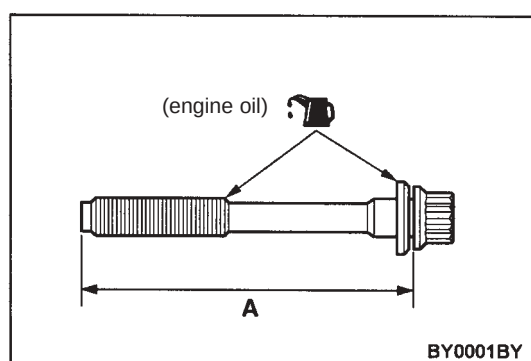
Fitting guidelines**▶ A ◀ Fitting the cylinder head gasket**

1. Remove the gaskets which have been stuck onto the surface of the gasket.

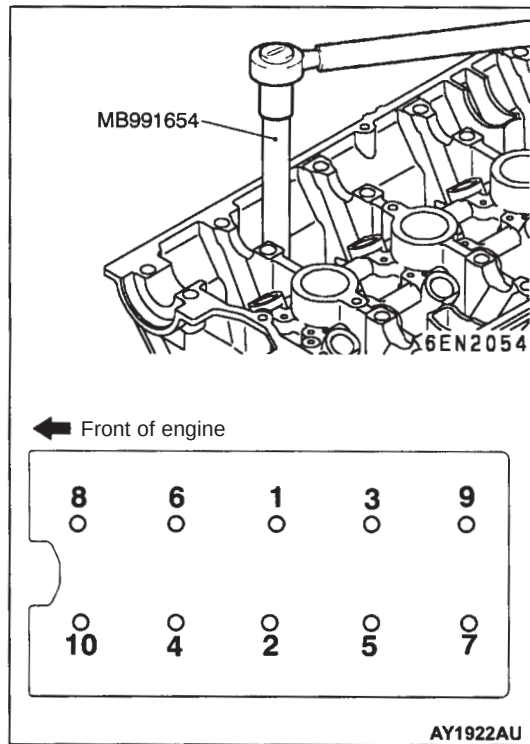
Caution

Do not allow any foreign matter to get into the channels for coolant or oil, or into the cylinder.

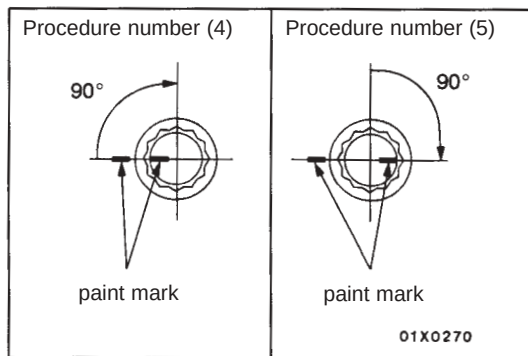
2. Fit the cylinder head gasket to the cylinder head, so that the holes in the cylinder head gasket match up with the holes in the cylinder head.

**▶ B ◀ Fitting the cylinder head bolts**

1. Check that the length of the body of cylinder head bolts is less than the maximum permitted. If the length is in excess of the maximum permitted, replace the bolt with a brand new one.
Maximum length (A): 99.4mm
2. Apply a small amount of engine oil to the screw thread of the bolt, and to the washer.



3. Use the special wrench for cylinder head bolts (MB991654) to (loosely) tighten the bolts in the following order.
 - (1) In the order shown in the diagram, tighten the bolts to $78 \pm 2 \text{ N}\cdot\text{m}$.
 - (2) In reverse order to that shown in the diagram, completely loosen the bolts.
 - (3) In the order shown in the diagram, tighten the bolts to $20 \pm 2 \text{ N}\cdot\text{m}$.



- (4) Make a paint mark on the top of the cylinder head bolt, and on the cylinder head, and tighten them to 90° as shown in the diagram.
- (5) Tighten the bolts to 90° as shown in the diagram, and check that the paint mark on the top of the cylinder head bolt and the paint mark on the cylinder head are in line.

Caution

- 1) If a bolt is tightened to an angle of less than 90° it has not been tightened sufficiently.
- 2) If the angle of tightening exceeds the regulation level, remove the bolt and start again from procedure number (1).

► C ◀ Fitting the O-ring/fuel high pressure hose

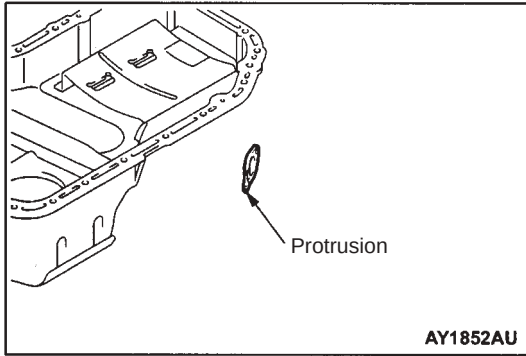
1. Apply a little fresh engine oil to the O-ring.

Caution

Ensure that engine oil does not get inside the delivery pipe.

2. Without damaging the O-ring, twist the fuel high pressure hose to fit it to the delivery pipe, making sure that it is twisted smoothly.
3. If the hose cannot be twisted smoothly, there is a possibility that it may be biting into the O-ring, so remove the fuel high pressure hose, and check for any damage to the O-ring. If the O-ring is undamaged, reinsert it into the delivery pipe and check once more whether the hose can be turned smoothly.
4. Tighten the mounting bolts for the fuel high pressure hose to the specified torque.

Tightening torque: $5.0 \pm 1.0 \text{ N}\cdot\text{m}$.

**► D ◀ Fitting the oil return pipe gasket**

Replace the gasket with a new one, and fit it to the protruded part shown in the diagram.

Note:

For the oil return pipe gasket on the turbocharger side, there is no direction for slotting it in.

► E ◀ Fitting the eyebolts

Caution

When tightening the eyebolts, hold the oil pipe joint in place with a spanner so that it does not turn round as the eyebolts are tightened.

TIMING BELT, TIMING BELT B

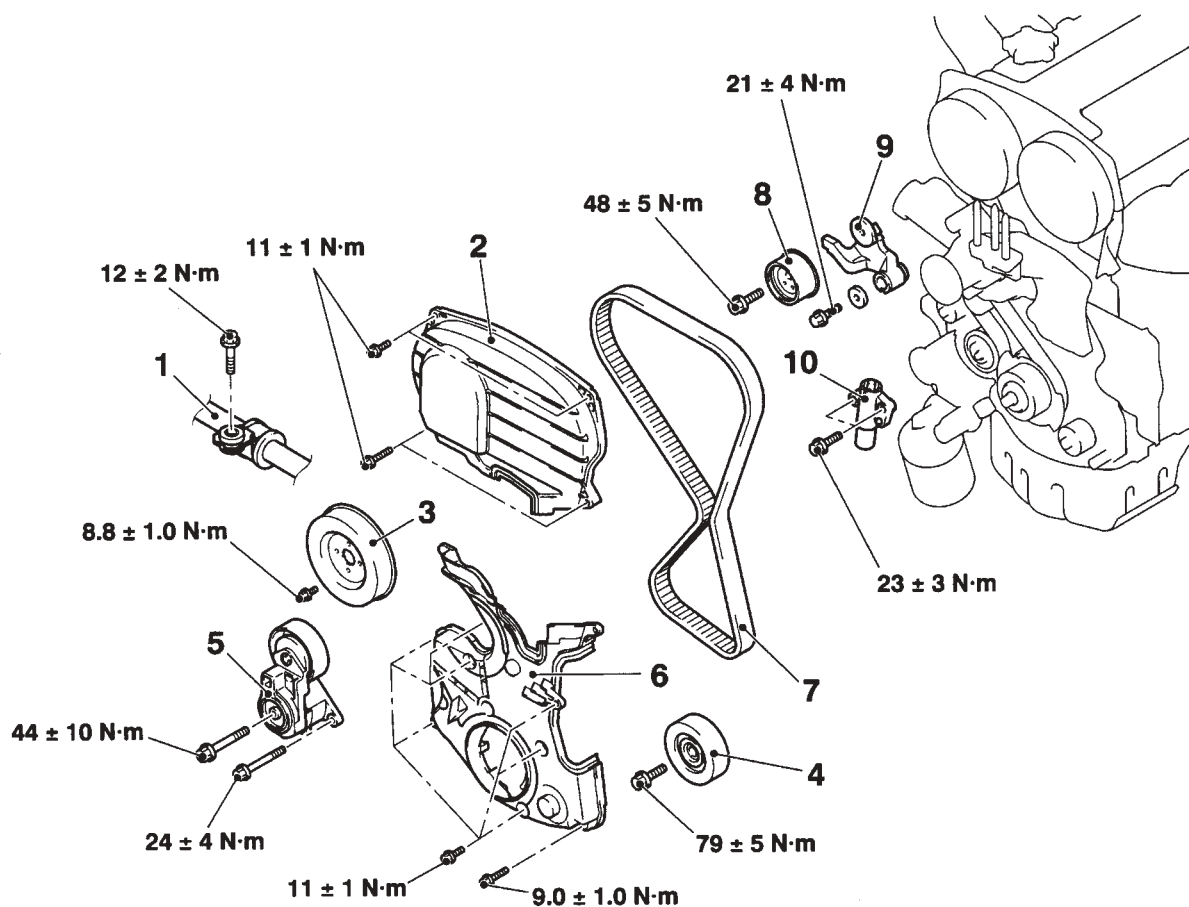
Removal and fitting

Caution

If Brembo brake callipers are being used take care that they are not scratched by other components or tools because there is a chance that the paint might peel off. In addition, if any brake fluid gets on the callipers, it should be wiped off immediately.

Jobs to be completed before removal and after fitting

- Removal and refitting of the valence. (Ref Section 51: Front bumper)
- Removal and refitting of the LH side cover.
- Checking and adjustment of the tension of the drive belt. <Only after fitting>
- Removal and refitting of the crankshaft pulley.
- Removal and refitting of the cross member bar.
- Removal and refitting of the front exhaust pipe.

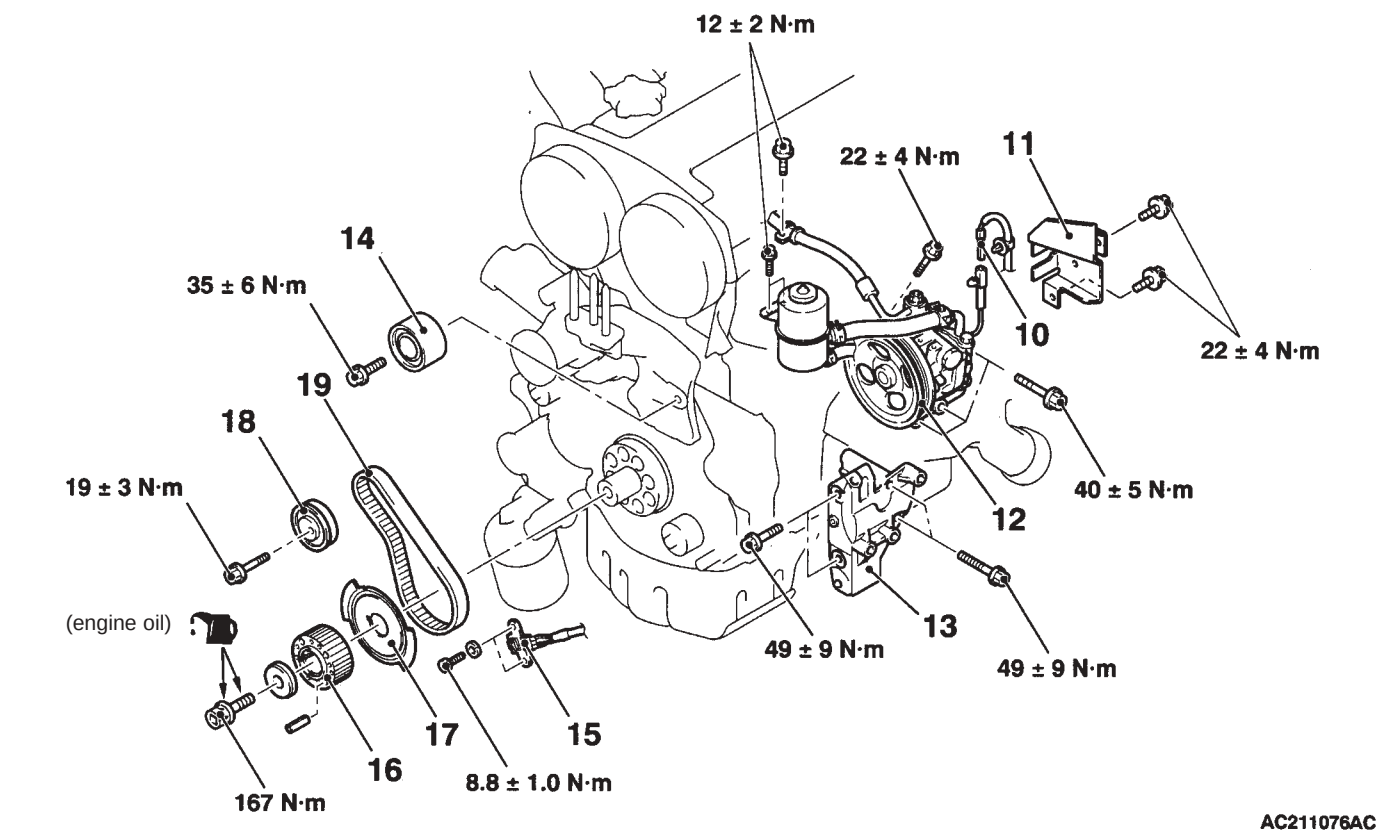


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Removal procedure

1. Pressure hose connection
2. Timing belt front upper cover
3. Water pump pulley
4. Idler pulley
5. Drive belt auto-tensioner
6. Timing belt front lower cover

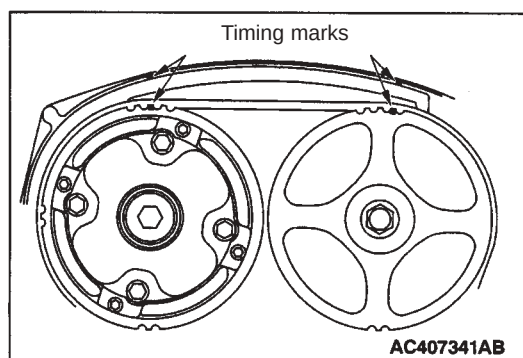
- Remove the engine mount bracket
- ▶ G ◀ • Adjust the tension of the timing belt <Only after fitting>
- ◀ A ▶ ▶ F ◀ 7. Timing belt
- ▶ E ◀ 8. Tensioner pulley
- 9. Tensioner arm
- ▶ D ◀ 10. Auto-tensioner



◀ B ▶

10. Power steering oil pressure switch connector
 11. Heat protector
 12. Power steering oil pump ASSY
 13. Power steering oil pump bracket
 14. Idler pulley
 15. Crank angle sensor

- ◀ C ▶ ▶ C ▶ 16. Crankshaft sprocket
 ▶ C ▶ 17. Crankshaft sensing blade
 ▶ B ▶ • Adjust the tension of the timing belt B
 <Only after fitting>
 ▶ A ▶ 18. Timing belt B tensioner
 ▶ D ▶ ▶ A ▶ 19. Timing belt B



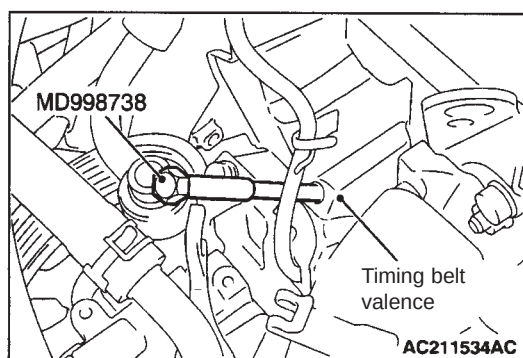
Removal guidelines

◀ A ▶ Removing the timing belt

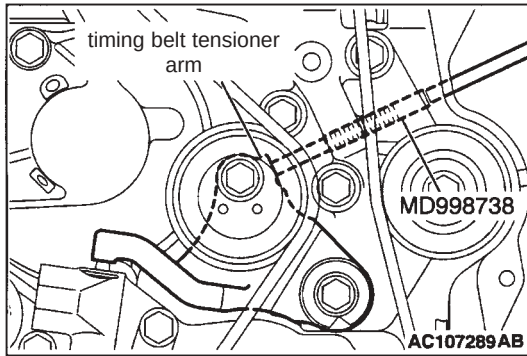
1. Turn the crankshaft in a clockwise direction, and match up all the timing marks until the No.1 cylinder is in the compressor top dead centre position.

Caution

Turn the crankshaft in the normal way.



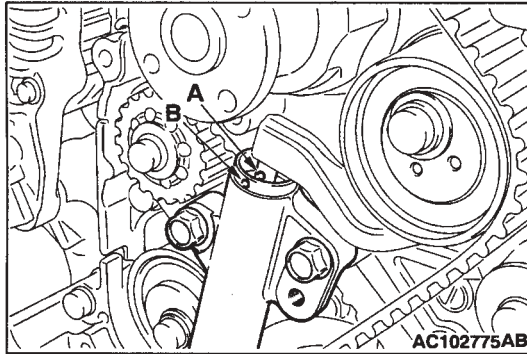
2. Remove the rubber plug from the rear cover of the timing belt, and prepare the special tool for adjusting bolts (MD998738).



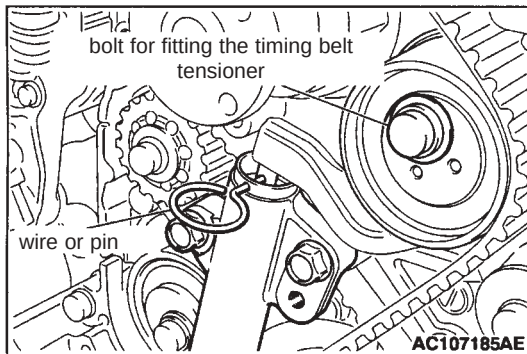
3. Twist the special tool for adjusting bolts (MD998738) by hand until it touches the tensioner arm.

Caution

The special tool for adjusting bolts (MD998738) can be slowly twisted at a rate of about 30° per second but if it is suddenly twisted the auto-tensioner rod cannot be easily withdrawn, and this may lead to problems with twisting and the possibility that the special tool for adjusting bolts (MD998738) may become bent.



4. Twist the special tool for adjusting bolts (MD998738) a little, and align the auto-tensioner rod with setting hole A, and the tensioner cylinder with setting hole B.



5. Insert a wire or a pin into the aligned holes.
6. Remove the special tool for adjusting bolts (MD998738), and then loosen the bolt for fitting the timing belt tensioner, and remove the timing belt.

Caution

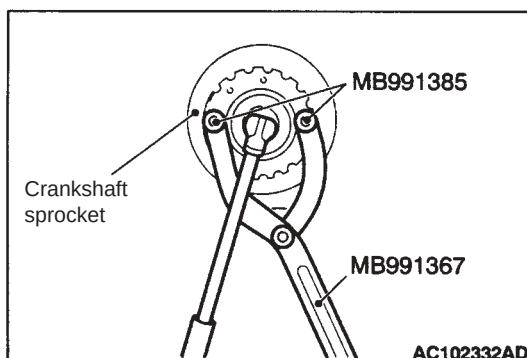
If a timing belt is being re-used, check and make a note of the direction of the arrows indicating the rotational direction (clockwise direction) on the back of the belt.

◀ B ▶ Removing the power steering oil pump ASSY

Remove the power steering oil pump ASSY from its bracket, with the hose intact.

Note

Secure the removed power steering oil pump ASSY with string, and put it somewhere where it will not hinder the removal or fitting of the timing belt.



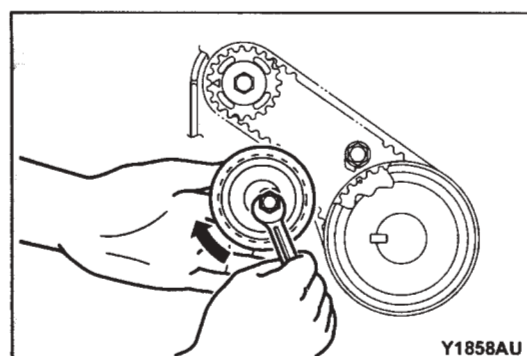
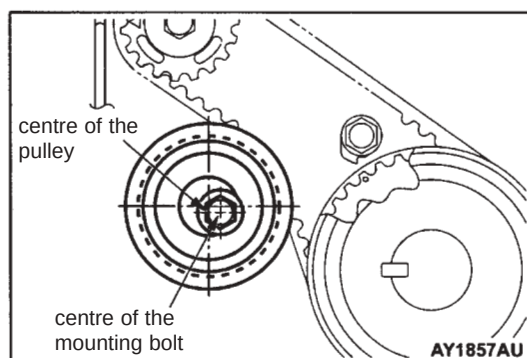
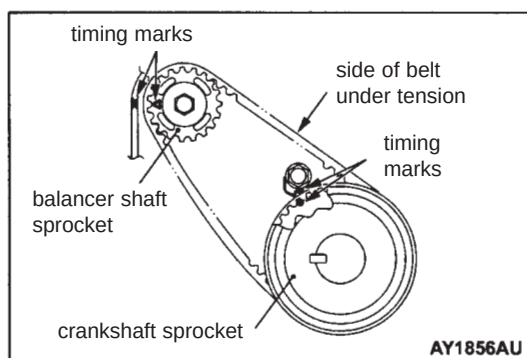
◀ C ▶ Removing the crankshaft sprocket

1. Hold the crankshaft sprocket in place using the special spanner (MB991367) and the special pin (MB991385).
2. Remove the crankshaft sprocket.

◀ D ▶ Removing timing belt B

Caution

If planning to re-use a timing belt B, ensure that it will be refitted the same way round, by marking the back of the belt with chalk arrows indicating the direction of movement.

**Fitting guidelines**▶ A ◀ **Fitting timing belt B and the timing belt B tensioner**

1. Check that the timing marks for the crankshaft sprocket and the balancer shaft sprocket are aligned.
2. Fit timing belt B onto the crankshaft sprocket and the balancer shaft sprocket. Ensure that the side of the belt under tension is not slack.
3. As a temporary step, fit the timing belt B tensioner pulley so that its centre is to the upper left of the centre of the mounting bolt, and so that the flange of the pulley is facing towards the front of the engine.
4. Adjust the tension of timing belt B.

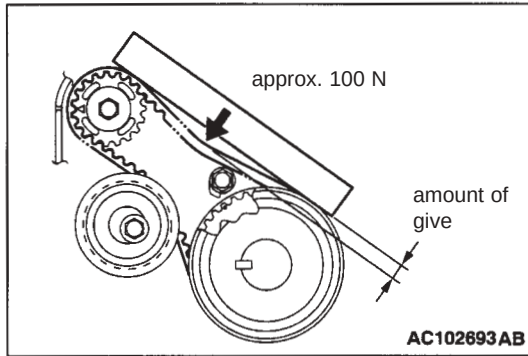
▶ B ◀ **Adjusting the tension of timing belt B**

1. Hold the timing belt B tensioner between fingertips and in the direction of the arrows, apply tension torque ($3.0 \pm 0.4 \text{ N}\cdot\text{m}$) to timing belt B until the side of the belt under tension becomes taught. In this condition, tighten the mounting bolt to the specified torque, and fit the tensioner.

Tightening torque: $19 \pm 3 \text{ N}\cdot\text{m}$

Caution

When tightening the mounting bolt, ensure that the tensioner does not turn round with it. If the tensioner turns with the mounting bolt, it could cause the tension in the belt to become too high.



2. <Measuring the amount of give>

- (1) As shown in the diagram, apply a force of about 100N to the middle of the belt between the sprockets (indicated by the arrow), and check that the amount of give is as specified.

Specified values:

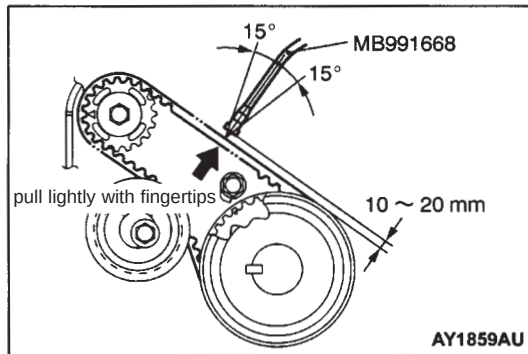
<when adjusted> 5~7mm

<when replaced> 5~7mm

- (2) If the specified values are not met, readjust the tension of the belt.

3. <When using MUT-II/III>

- (1) Connect the special belt tension meter set (MB991668) to the MUT-II/III.
- (2) Connect the special battery harness (MB991704) to the MUT-II/III, and also connect it to the batteries.
- (3) Give the crankshaft two turns in a clockwise direction, and check that the No.1 cylinder is in the top dead centre position, and that the timing marks on each sprocket are aligned.
- (4) Select the "belt tension measurement" option from the display on the MUT-II/III.



- (5) As shown in the diagram hold the special belt tension meter set (MB991668) in the middle of the belt between the sprockets (indicated by the arrow), 10~20mm away from the outer side of the belt and vertically to the belt (not leaning more than $\pm 15^\circ$ away from vertical).

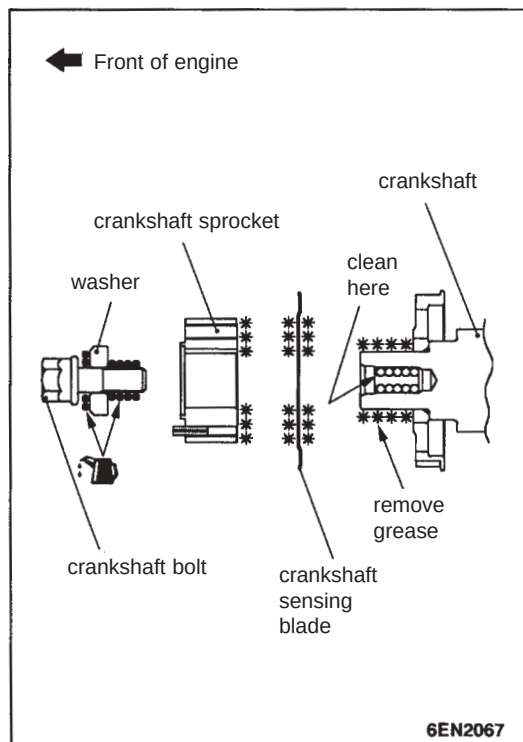
- (6) As shown in the diagram, lightly pull the middle of the belt between the sprockets (indicated by the arrow) using fingertips and check that the vibration frequency of the belt is within the limits specified.

Specified values: 76 ~ 92 Hz

Caution

- (1) The meter may give an incorrect reading if the microphone is affected by a strong wind, or if there are loud noises nearby, while testing is taking place.
- (2) The meter may give an incorrect reading if testing is performed while the microphone is touching the belt.

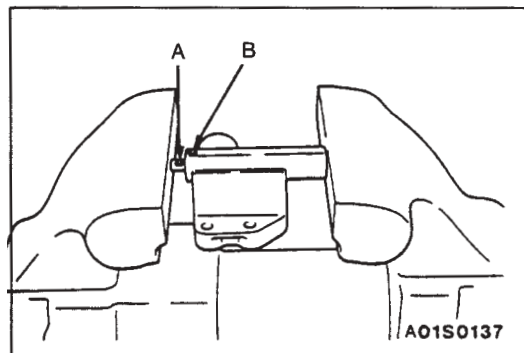
- (7) If the specified values are not met, readjust the tension of the belt.



► C ◄ Fitting the crankshaft sensing blade and the crankshaft sprocket

1. Clean, and remove any grease from the crankshaft sensing blade, the crankshaft sprocket, and the surface of the crankshaft to which the crankshaft sprocket will be fitted.
2. Fit the crankshaft sensing blade and the crankshaft sprocket in the direction shown in the diagram.
3. Clean the screw hole in the crankshaft.
4. Place the washer with the larger surface side in the direction as shown in the diagram, and fit it to the crankshaft bolt.
5. Apply a small quantity of engine oil to the top and to the screw thread parts of the crankshaft bolt.
6. In the same way as when it was removed, hold the crankshaft sprocket using the special tool, and tighten the crankshaft bolt to the specified torque.

Tightening torque: 167 N·m

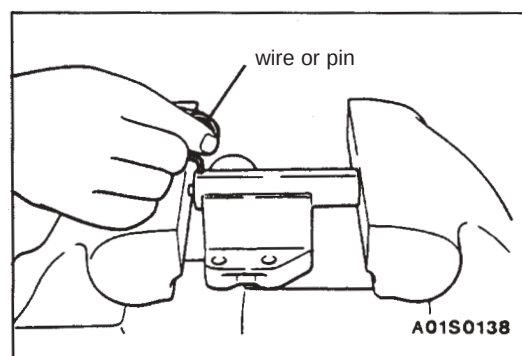


► D ◄ Fitting the auto-tensioner

1. If the auto-tensioner rod remains in an extended state, install it using the following procedure.
 - (1) Using a press or a vice, slowly compress the auto-tensioner rod and align the rod with setting hole A and the tensioner cylinder with setting hole B.

Caution

If the speed of compression is too fast, there is a chance that the rod may break, so carry out this operation slowly.



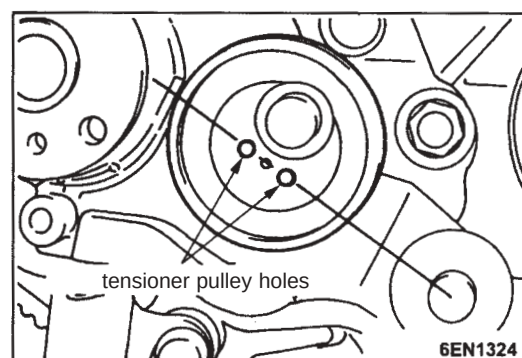
- (2) Insert a wire or pin into the aligned holes.

Note

If a brand new or a replacement auto-tensioner is being used, use a pin to set the auto-tensioner in place.

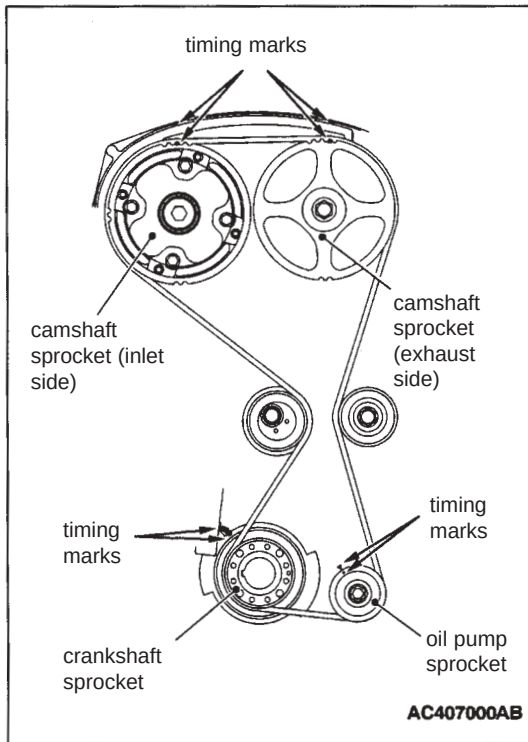
2. Fit the auto-tensioner into the engine and tighten the mounting bolt to the specified torque. Do not remove the wire or pin until the tension of the timing belt has been adjusted.

Tightening torque: 23 ± 3 N·m



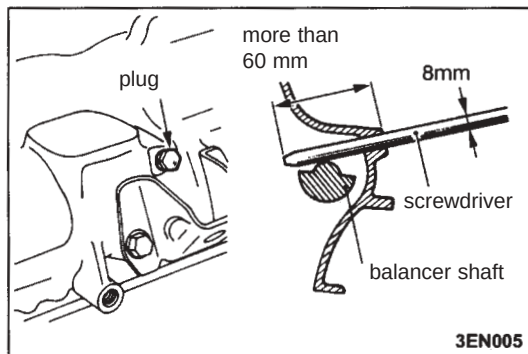
► E ◄ Fitting the tensioner pulley

As a temporary step, fit the tensioner pulley as shown in the diagram.

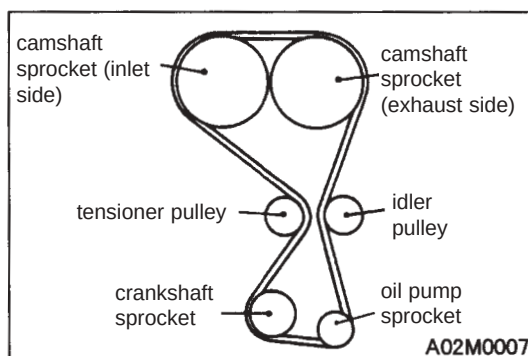


► F4 Fitting the timing belt

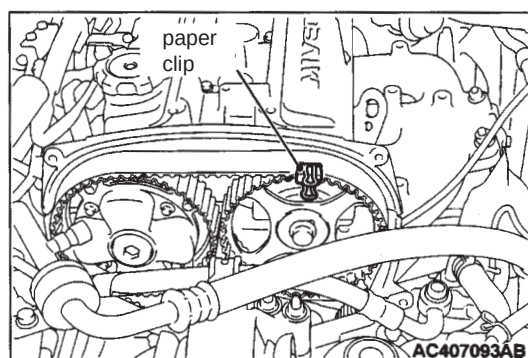
1. Check that all the timing marks for the camshaft sprocket, the crankshaft sprocket and the oil pump sprocket are aligned.



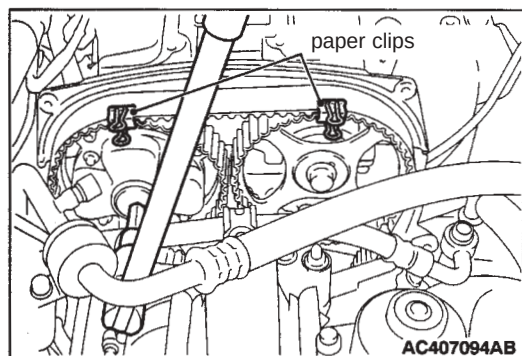
2. After the timing marks for the oil pump sprocket have been aligned, remove the plug from the cylinder block and insert a posidrive (+) with a diameter of 8 mm into the plug hole. Check that more than 60 mm of the shaft of the screwdriver can be inserted. If the screwdriver strikes the balancer shaft and can only be inserted to a depth of 20 ~ 25 mm, turn the sprocket one complete turn, realign the timing marks, and check that more than 60 mm of the screwdriver can be inserted. Do not remove the screwdriver until the timing belt has been fitted.



3. Install the timing belt in accordance with the following guidelines so that the side that is under tension does not get slack.
 - (1) Fit the timing belt around the crankshaft sprocket first, then the oil pump sprocket and then fit it around the idler pulley.



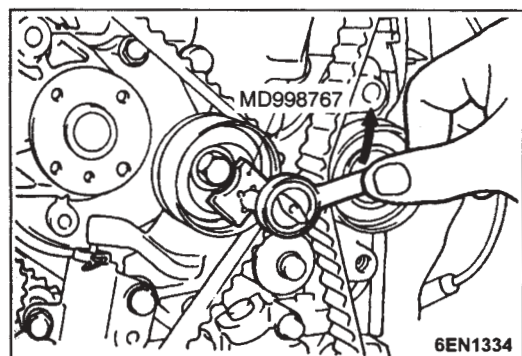
- (2) Fit the timing belt around the camshaft sprocket (exhaust side) and hold it in place with a paper clip at the position shown in the diagram.



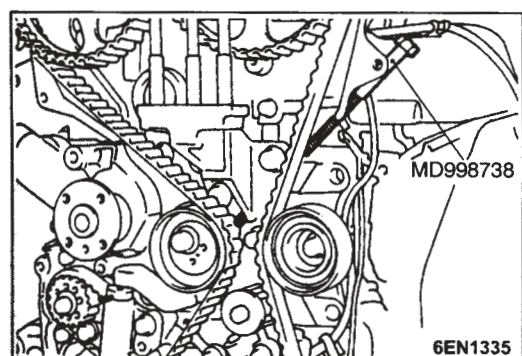
- (3) Use a wrench to align the timing marks on the rocker cover and the camshaft sprocket, and whilst doing so, fit the timing belt around the camshaft sprocket (inlet side) and hold it in place with a paper clip at the position shown in the diagram.
- (4) Fit the timing belt around the tensioner pulley.
- (5) Remove the two paper clips.

Caution

After the timing belt has been installed, apply some force in an anti-clockwise direction to the camshaft sprocket and check once more that all the timing marks are in the correct position when the side of the belt under tension is taught.



4. Using the special wrench for the tensioner pulley socket (MD998767), tense the timing belt by turning the tensioner pulley in the direction shown in the diagram, and temporarily tighten the mounting bolt for the tensioner pulley.
5. Check that all the timing marks are aligned.
6. Remove the screwdriver, and replace the plug.
7. Adjust the tension of the timing belt.



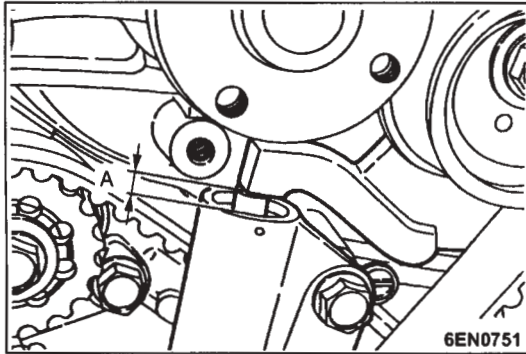
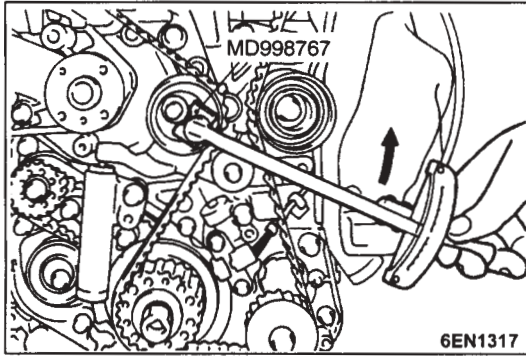
► G ◀ Adjusting the tension of the timing belt

1. Remove the rubber plug from the rear cover of the timing belt and put the special adjusting bolt (MD998738) in position. Slowly twist the adjusting bolt a little at a time, so that the wire or pin inserted when fitting the auto-tensioner, only moves a little.

Caution

There is a possibility that the wire or pin inserted in the auto-tensioner may break if the adjusting bolt is twisted with a spanner or a similar tool, so it must be twisted by hand.

2. Turn the crankshaft a quarter turn in an anti-clockwise direction.
3. Turn the crankshaft in a clockwise direction, realign all the timing marks and set the No.1 cylinder in the top dead centre position.
4. Loosen the mounting bolt for the tensioner pulley which had been temporarily tightened.



5. Using the special wrench for the tensioner pulley socket (MD998767) or a torque wrench, apply tension torque (3.5 N·m) to the timing belt in the direction shown in the diagram, and tighten the mounting bolt for the tensioner pulley to the specified torque.

Tightening torque: 48 ± 5 N·m

Caution

When tightening the installed bolt, take care that the tensioner pulley does not turn around with it. If the pulley does turn around with the bolt, the tension of the belt will become too strong.

6. Remove the wire or pin which had been inserted when the auto-tensioner was fitted.
7. Remove by hand the special adjusting bolt (MD998738) which had been fitted in step 1.
8. Turn the crankshaft two complete turns in a clockwise direction, and leave it for about 15 minutes.
9. Reinsert the wire or pin which had been removed in step 6, and check that it can be easily pulled out again. If the wire or pin can be easily pulled out the tension of the timing belt is just right, so the wire or pin should be removed completely. At this point check that the auto-tensioner rod is not projecting more than the amount specified.

Specified projection (A): 3.8 ~ 4.5 mm

10. If the wire or pin cannot be easily pulled out, repeat steps 1 to 8 until the tension of the timing belt is just right.
11. Recheck that the timing marks on all of the sprockets are in line.

Caution

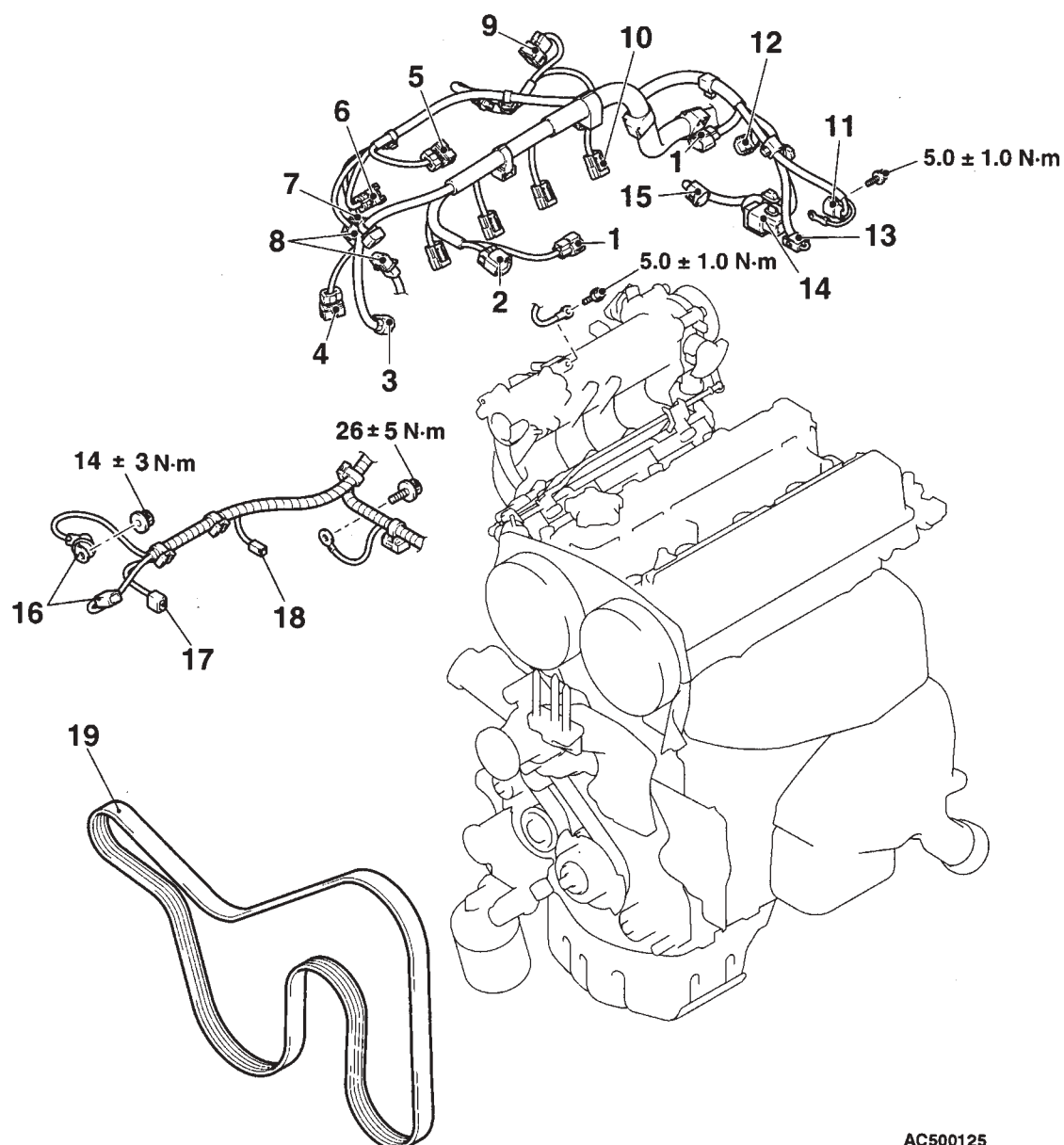
If the crankshaft bolt is turned in an anti-clockwise direction, the tightening torque of the crankshaft bolt must be checked, and if it is loose, it must be retightened.

ENGINE ASSY

Removal and fitting

Jobs to be completed before removal and after fitting

- Measures to prevent fuel leaking. <Only before removal>
- Check for fuel dripping. <Only after fitting>
- Removal and refitting of the bonnet.
- Removal and refitting of the strut tower bar.
- Removal and refitting of the valence. (Ref Section 51: Front bumper)
- Checking the tension of the drive belt. <Only after fitting>
- Adjustment of the axle letter cable. <Only after fitting>
- Draining and replacing the engine oil.
- Draining and replacing the coolant.
- Removal and refitting of the air cleaner.
- Removal and refitting of air pipe C.
- Removal and refitting of the battery and the battery tray.
- Removal and refitting of the centre cover. (Ref P11-5)
- Removal and refitting of the axle letter cable.
- Removal and refitting of the radiator.
- Removal and refitting of the front exhaust pipe.



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Removal procedure

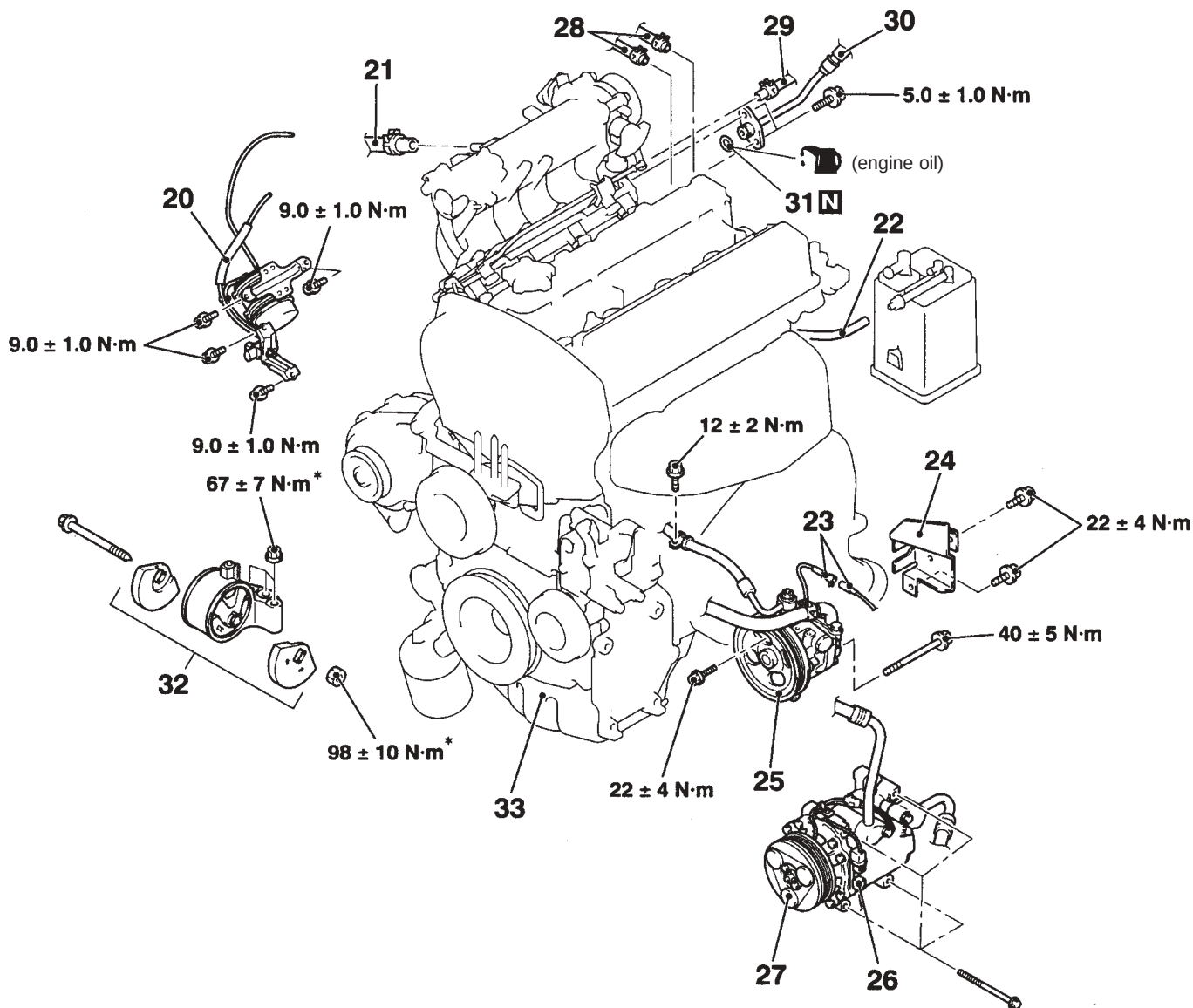
1. Ignition coil connector
2. O₂ sensor connector
3. Oil feeder control valve connector
4. Crank angle sensor connector
5. Manifold absolute pressure sensor connector
6. Fuel pressure solenoid valve connector
7. Knock sensor connector
8. Purge control solenoid valve connector
9. Throttle position connector
10. Injector connector

11. Exhaust cam position sensor connector
12. Inlet cam position sensor connector
13. Water temperature gauge unit connector
14. Joint control harness and transmission harness
15. Water temperature sensor connector
16. Alternator connector and terminal
17. Secondary air control solenoid valve connector
18. Engine oil pressure switch connector
19. Drive belt

◀ A ▶

Caution

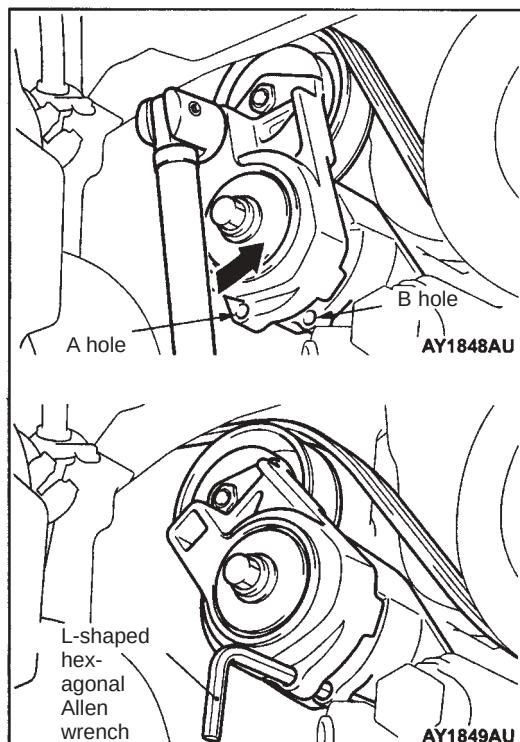
Parts marked * should be temporarily tightened, and then tightened properly when the full weight of the engine is being supported by the chassis.



AC407015AB

20. Vacuum tank, solenoid valve, vacuum pipe and hose ASSY
 21. Brake booster vacuum hose connection
 22. Purge hose connection
 23. Power steering oil pressure switch connector
 24. Heat protector
 25. Power steering oil pump
 26. A/C compressor connector
 <For cars fitted with A/C>
 27. A/C compressor <For cars fitted with A/C>

28. Heater hose connection
 29. Fuel return hose connection
 30. Fuel high pressure hose connection
 31. O-ring
 • Transfer ASSY, transmission ASSY
 32. Engine mount bracket & stopper ASSY
 33. Engine ASSY



Removal guidelines

◀ A ▶ Removing the drive belt

The following operations are necessary because the engine uses a serpentine drive system with auto-tensioner.

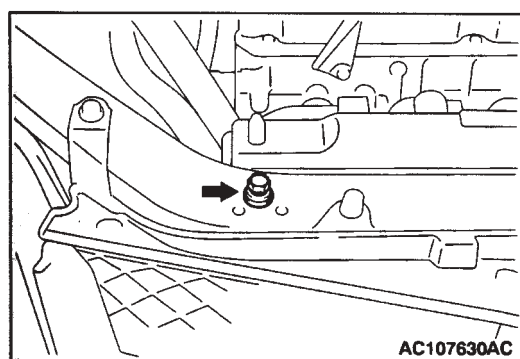
1. Insert a 12.7sq spinner handle into the auto-tensioner tool hole, and turn the auto-tensioner in an anti-clockwise direction before it reaches the stopper.
2. Align hole A and hole B, insert an L-shaped hexagonal Allen Key, to hold the position, and remove the drive belt.

Caution

If planning to re-use the drive belt, ensure that it will be refitted the same way round, by marking the back of the belt with chalk arrows indicating the direction of movement.

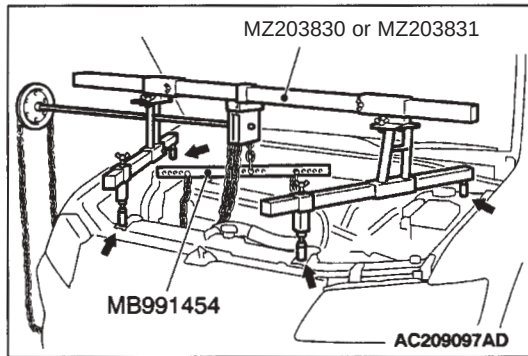
◀ B ▶ Removing the power steering oil pump and the A/C compressor

1. Remove the power steering oil pump and the A/C compressor from the bracket with the hoses intact.
2. Secure the removed power steering oil pump and the removed A/C compressor with string, and put them somewhere where they will not hinder the removal or fitting of the engine ASSY.



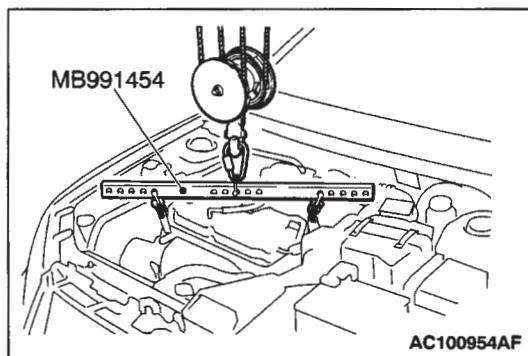
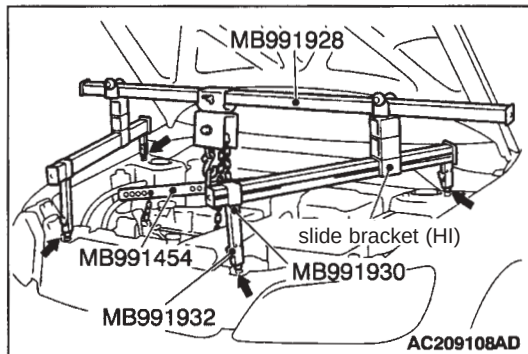
◀ C ▶ Removing the transfer ASSY and the transmission ASSY

1. In order to prepare the special mechanical engine hanger (MZ203830, MZ203831 or MB991928), the radiator support upper insulator mounting bolts should be tightened on the chassis (2 places).
2. Remove the transfer ASSY and the transmission ASSY.



◀ D ▶ Removing the engine mount bracket & stopper ASSY

1. Support the engine using a garage jack.
2. Remove the special mechanical engine hanger (MZ203830, MZ203831 or MB991928).



3. Hold the engine ASSY using a chain block.
4. Support the engine oil pan component with the garage jack through the engine block, so that the weight of the engine is not taken by the engine mount bracket.
5. Loosen the nuts and bolts and remove the engine mount bracket and stopper ASSY.

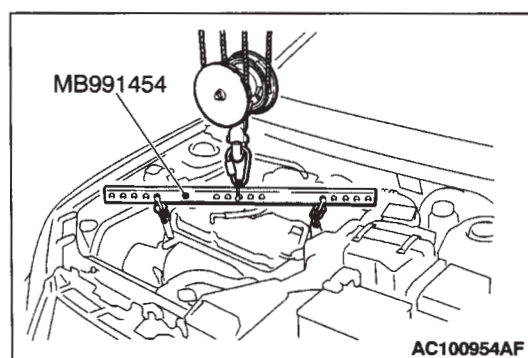
◀ E ▶ Removing the engine ASSY

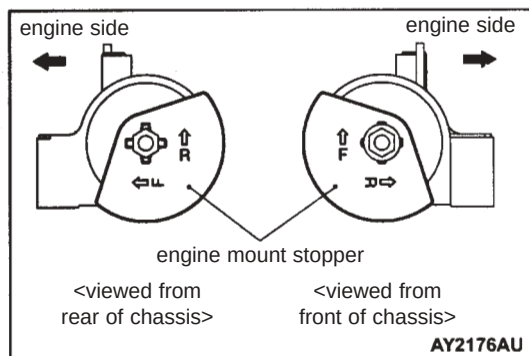
After checking that all of the cables, hoses and harness connectors etc have been disconnected, slowly hoist the engine using a chain block and remove the engine from the engine compartment.

Fitting guidelines

▶ A ▶ Fitting the engine ASSY

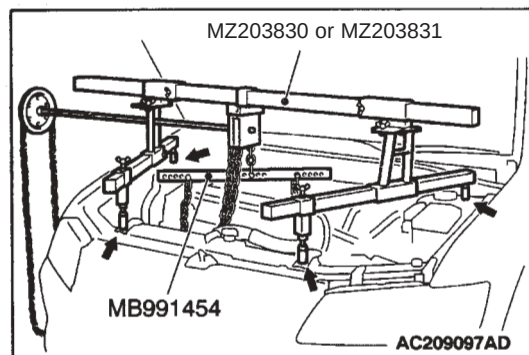
Install the engine whilst checking that cables, hoses and harness connectors etc will not be squashed beneath it.



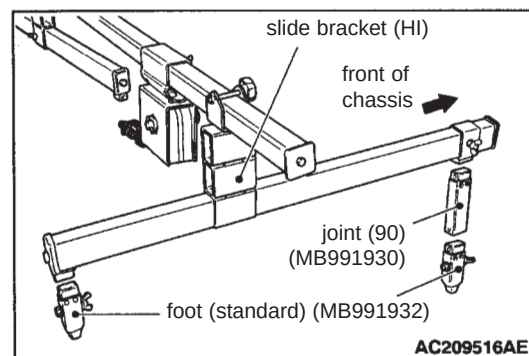


► B ◀ Fitting the engine mount bracket & stopper ASSY

1. Support the engine oil pan component with the garage jack through the engine block, and fit the engine mount bracket & stopper ASSY whilst checking the position of the engine. Fix the engine mount stopper so that the arrow points in the direction shown in the diagram.
2. Support the engine ASSY with a garage jack.
3. Remove the chain block.
4. In the same way as when it was removed, hold the engine ASSY with the special tool.



- (1) <When using the special mechanical engine hanger (MZ203830 or MZ203831)>
Install the special mechanical engine hanger (MZ203830 or MZ203831).

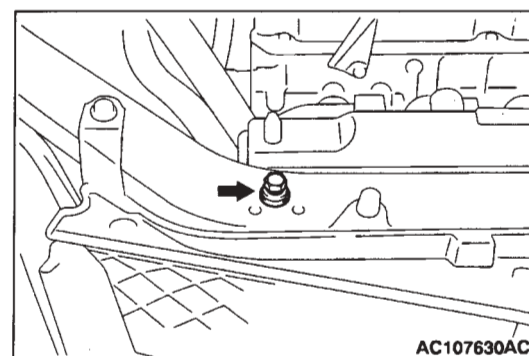
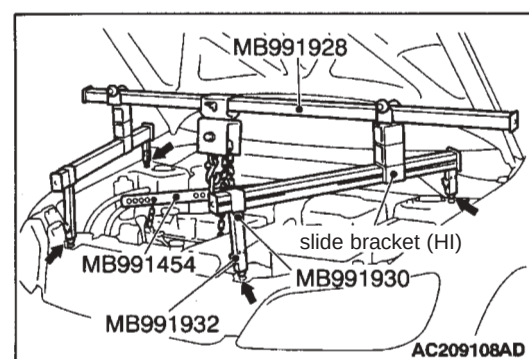


- (2) <When using the special engine hanger (MB991928)>

Fit the following parts to the base hanger.

- Slide bracket (HI)
- Foot (standard) (MB991932)
- Joint (90) (MB991930)

Install the special engine hanger (MB991928)



► C ◀ Fitting the transfer ASSY and the transmission ASSY

1. Fit the transfer ASSY and the transmission ASSY.
2. Remove the radiator support upper insulator mounting bolts from the chassis (2 places).

◀ D ▶ Fitting the O-ring and the fuel high pressure hose

1. Apply a little fresh engine oil to the O-ring.

Caution

Ensure that no engine oil gets inside the deliver pipe.

2. Without damaging the O-ring, fit the fuel high pressure hose to the delivery pipe by twisting it from left to right. Ensure that the hose is twisted smoothly.
3. If the hose cannot be twisted smoothly, there is a possibility that it may be biting into the O-ring, so remove the fuel high pressure hose, and check for any damage to the O-ring. If the O-ring is undamaged, reinsert it into the delivery pipe and check once more whether the hose can be turned smoothly.
4. Tighten the mounting bolts for the fuel high pressure hose, to the specified torque.

Tightening torque: 5.0 ± 1.0 N•m.

SECTION 13A

MPI (Multi-point Fuel Injection)

CONTENTS

General	2	Servicing the vehicle	29
Servicing standards	3	1. Adjusting specified revolutions when idling	29
Special tools	3	2. MPI system components layout diagram	29
Troubleshooting	5	3. Checking the air temperature sensor	29
		4. Checking the oil feeder control valve	30

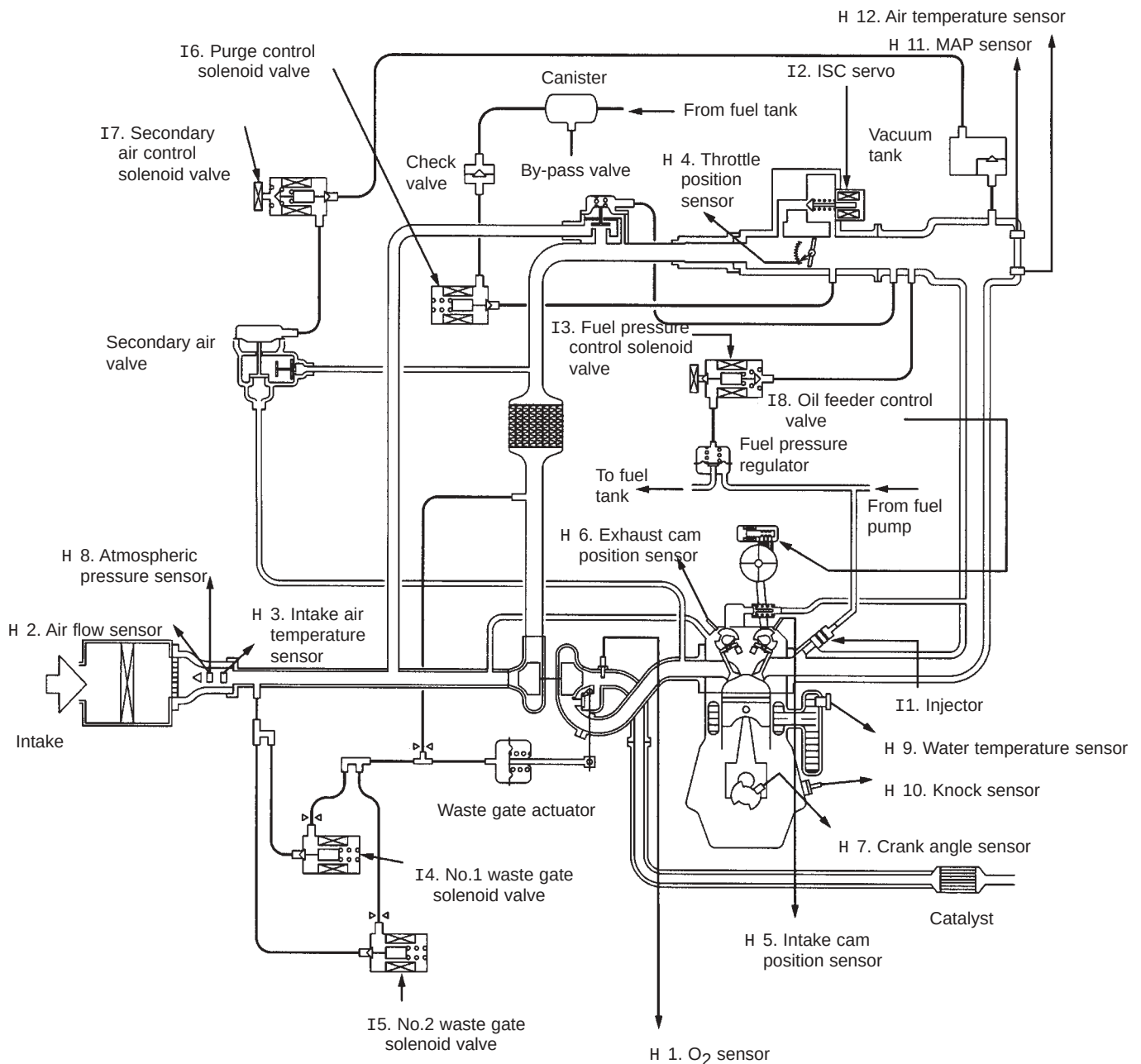
GENERAL

Servicing guidelines have been changed because of the changes listed below.

- A variable valve timing control system (V.V.T.) has been adopted. Because of this, an oil feeder control valve and an intake cam position sensor have been added.
- A manifold absolute pressure (MAP) sensor has been added.
- An air temperature sensor has been added.

MPI system diagram

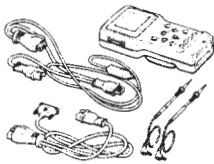
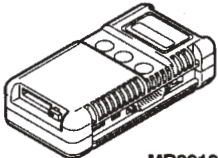
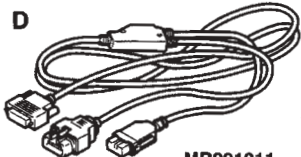
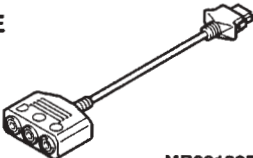
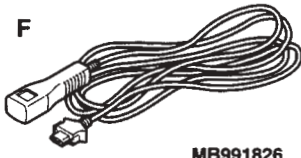
H 1. O ₂ sensor H 2. Air flow sensor H 3. Intake air temp. sensor H 4. Throttle position sensor H 5. Intake Cam position sensor H 6. Exhaust Cam position sensor H 7. Crank angle sensor H 8. Atmospheric pressure sensor H 9. Water temp. sensor H 10. Knock sensor H 11. Manifold absolute pressure (MAP) sensor H 12. Air temp. sensor	• Power supply • Ignition switch IG • Ignition switch ST • Vehicle speed sensor • A/C switch • A/C load signal • Power steering fluid pressure switch • Alternator FR signal • Inter-cooler water spray switch (auto) • Inter-cooler water spray switch (manual)	È Engine ECU È	I1. Injector I2. ISC servo (Stepper motor) I3. Fuel pressure control solenoid valve I4. No. 1 Waste gate solenoid valve I5. No. 2 Waste gate solenoid valve I6. Purge control solenoid valve I7. Secondary air control solenoid valve I8. Oil feeder control valve	• Engine control relay • Fuel pump relay 2,3 (ON/OFF) • Fuel pump relay (HI/LO switch) • A/C relay • Ignition coil • Fan controller • Condenser fan relay (HI) • Condenser fan relay (LO) • Engine warning light • Diagnosis output terminal • Alternator G terminal • Inter-cooler water spray relay • Inter-cooler water spray lamp • O₂ sensor heater
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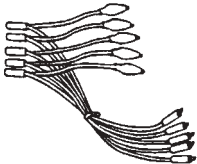
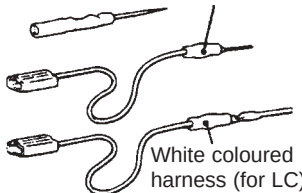


Servicing standards

Item		Standard level
Revolutions when idling r/min		800 ± 50
Air temperature sensor resistance kΩ	at -20 °C	13~18
	at 0 °C	5.1~6.9
	at 20 °C	2.0~3.0
	at 40 °C	0.9~1.5
	at 60 °C	0.40~0.78
	at 80 °C	0.23~0.42
Oil feeder control valve resistance (at 20 °C) Ω		6.9~7.9

Special tools

Tool	Number	Name	Function
	MB991502	MUT-II sub ASSY	Checking the MPI system
A  MB991824 B  MB991827 C  MB991910 D  MB991911 E  MB991825 F  MB991826 MB991955	MB991955 A: MB991824 B: MB991827 C: MB991910 D: MB991911 E: MB991825 F: MB991826	MUT-III sub ASSY A: Vehicle Communication Interface (V.C.I.) B: USB cable C: MUT-III Main harness A (For vehicles fitted with CAN) D: MUT-III Main harness B (For vehicles not fitted with CAN) E: Adaptor F: Trigger harness	Note If a MUT-III main harness A is connected to a vehicle not fitted with CAN, there is a chance that a pulse signal will be entered in the simulated vehicle speed line, when the MUT-III is activated. Therefore, use a MUT-III main harness B with vehicles not fitted with CAN.

Tool	Number	Name	Function
	MB991348	Test harness	Inspection using an oscilloscope
	MB991709	Test harness	• Troubleshooting voltage measurement • Inspection using an oscilloscope
	MB991658	Test harness	Inspection using an oscilloscope
	MD998478	Test harness (3P, triangular)	• Troubleshooting voltage measurement • Inspection using an oscilloscope
Red coloured harness (for DLI)  White coloured harness (for LC) 00005906	MB991223	Inspection harness set connector • Pin contact pressure inspection harness • Commercial tester connection probe (for ordinary connectors)	Terminal voltage measurement

TROUBLESHOOTING

1. Diagnosis Functions

1-1 Engine warning light (Check engine lamp)

Changes have been made to engine warning lights.

Checklist for engine warning lights.

Engine ECU
Air flow sensor (AFS)
Manifold absolute pressure (MAP) sensor system
Intake air temperature sensor
Throttle position sensor (TPS)
Water temperature sensor
Crank angle sensor
Exhaust cam position sensor
Injector
Ignition coil (with built-in power transistor)
Atmospheric pressure sensor
O ₂ sensor
O ₂ sensor heater
Fuel system malfunction
Knock sensor
Intake cam position sensor system
Oil feeder control valve system

1-2 Checking of freeze frame data

Additions have been made to the freeze frame data tables.

Checklist for data tables

Item number	Type of data	Units/condition
95	MAP sensor	kPa

1-3 Failsafe and back-up functions

If one of the diagnosis functions detects that one of the main sensors is malfunctioning, it will ensure that the car can be driven safely, in accordance with the pre-set control logic.

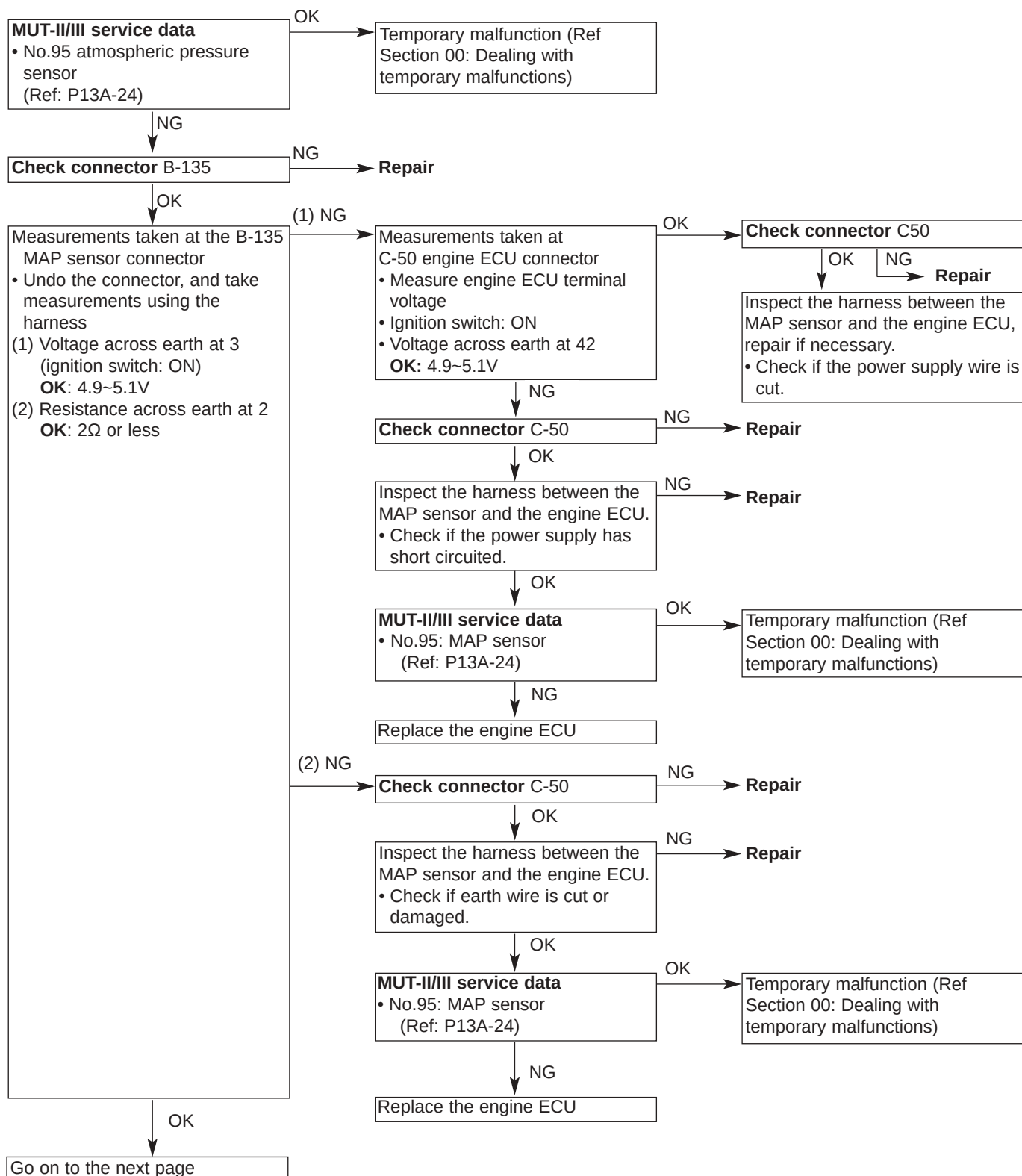
Malfunctioning item	Control measures taken when a malfunction occurs
Air temperature sensor	Regulation of the intake air temperature at 25°C.
Exhaust cam position sensor	(1) Simultaneous flushing out of all fuel pipes. (But only if the No. 1 cylinder has not been detected in the TDC position after the ignition switch has been turned "ON".) (2) Cutting off the fuel 4 seconds after the malfunction has been detected. (But only if the No. 1 cylinder has not been detected in the TDC position after the ignition switch has been turned "ON".)
Intake cam position sensor	The oil feeder control valve should be switched "OFF", and the angle of the cam should be in the reset position.

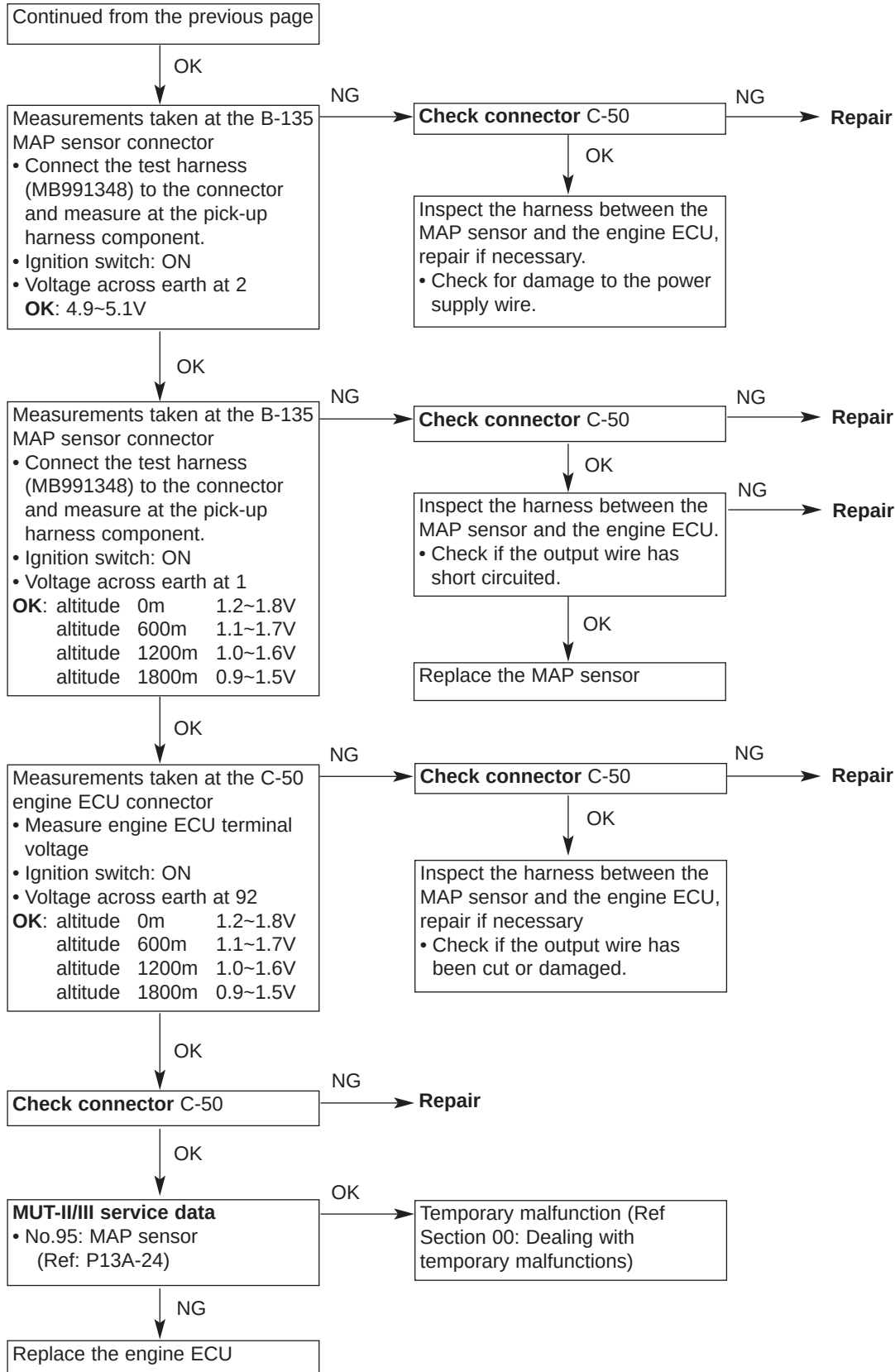
2. Diagnosis code classification table

Code No.	Diagnosis item	Page
P0105	MAP sensor	13A-7
P0340	Exhaust cam position sensor system	13A-9
P1012	Intake cam position sensor system	13A-11
P1021	Oil feeder control valve system	13A-13
P2226	Atmospheric pressure system	13A-14

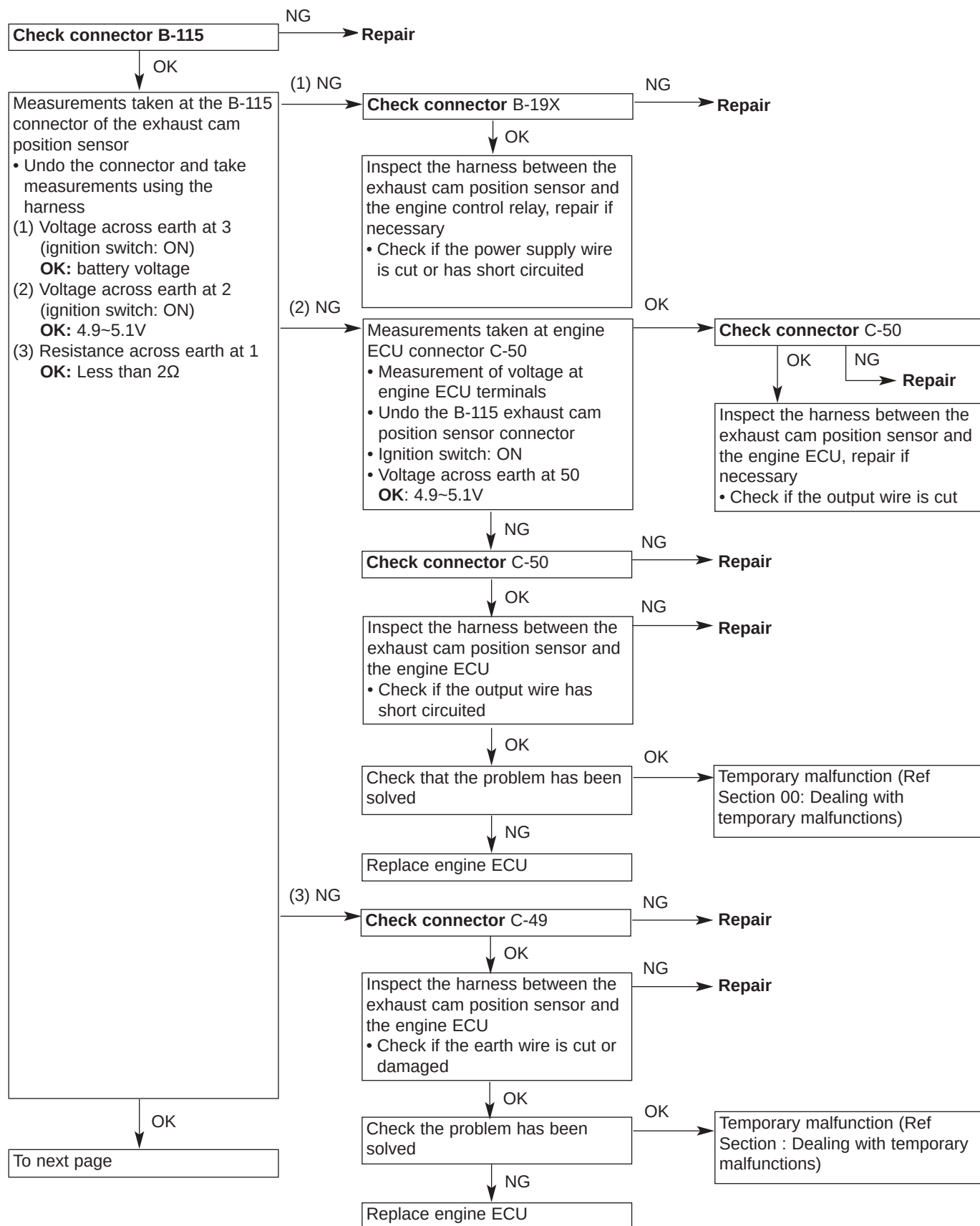
3. INSPECTION PROCEDURES FOR EACH DIAGNOSIS CODE

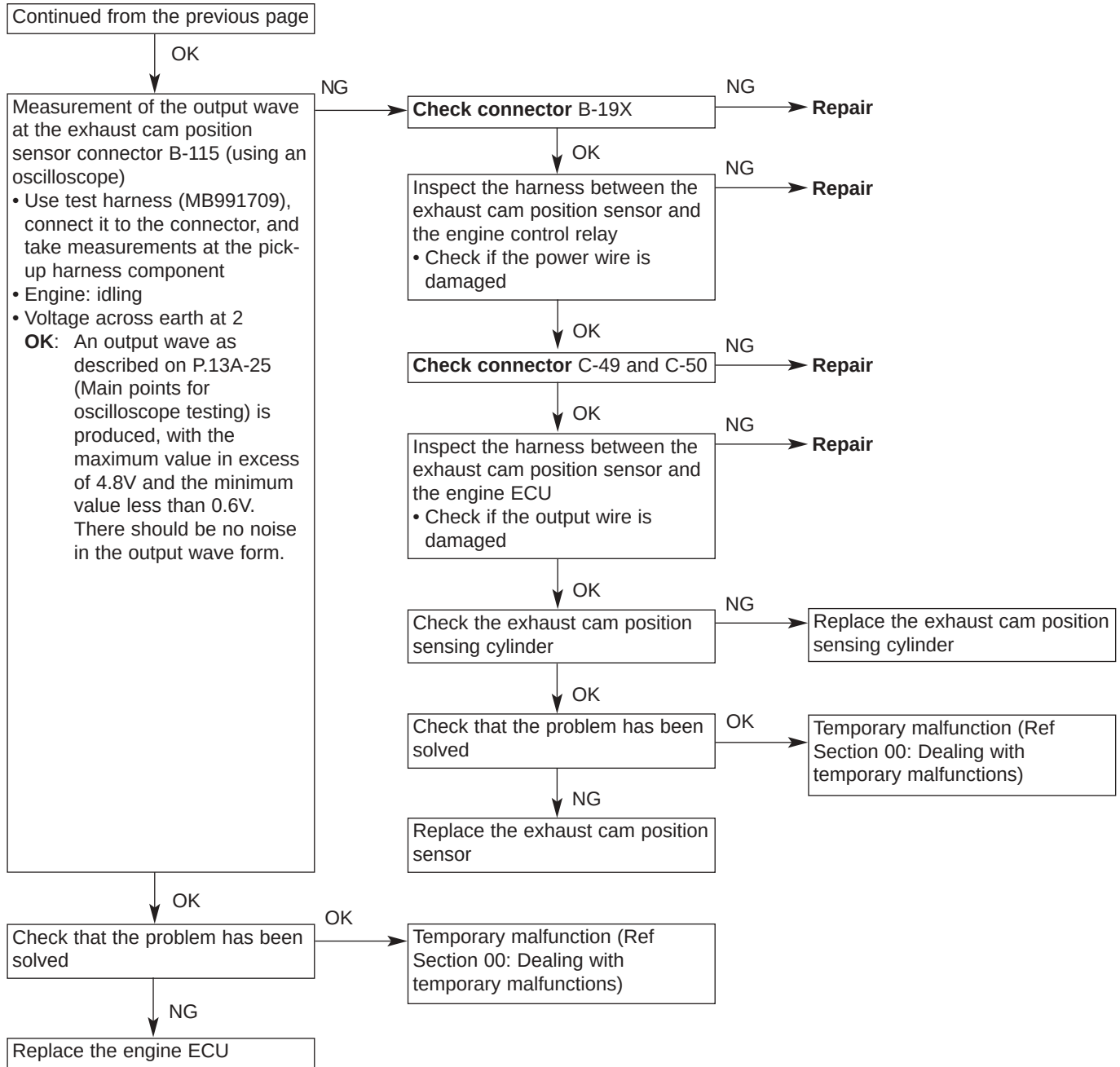
Code No. P0105 MAP sensor system	Probable cause of the malfunction
Conditions for the inspection • Ignition switch: ON • Wait for 2 seconds after the ignition switch has been turned on or the engine has started. Evaluation conditions • Sensor output voltage is 4.6V or more for 4 seconds (when atmospheric pressure is more than 313 kPa) • Sensor output voltage is 0.2V or less for 4 seconds (when atmospheric pressure is more than 14 kPa)	• MAP sensor malfunction • Broken circuit or short circuit in the MAP sensor circuit • Poor connector contact • Engine ECU malfunction



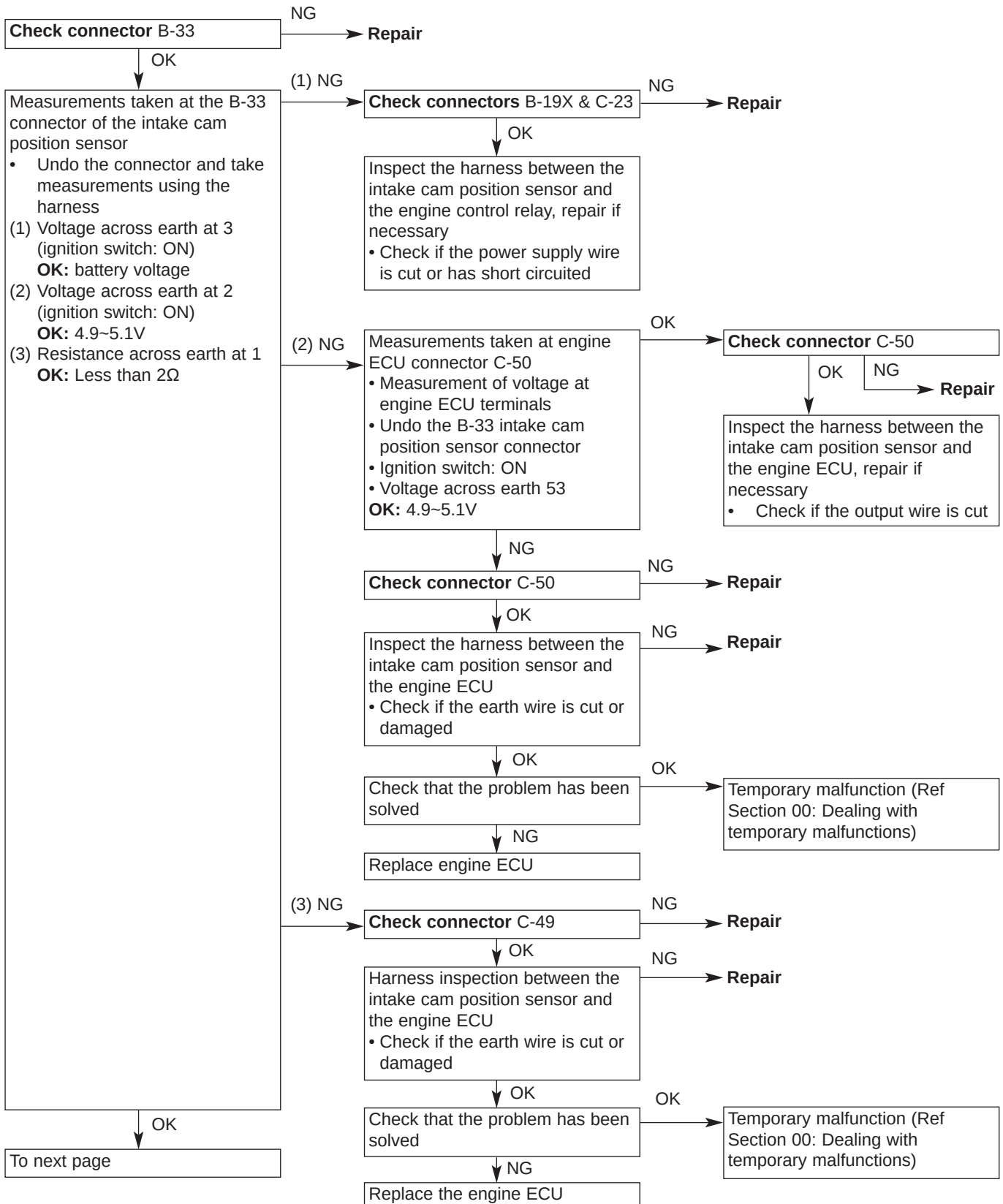


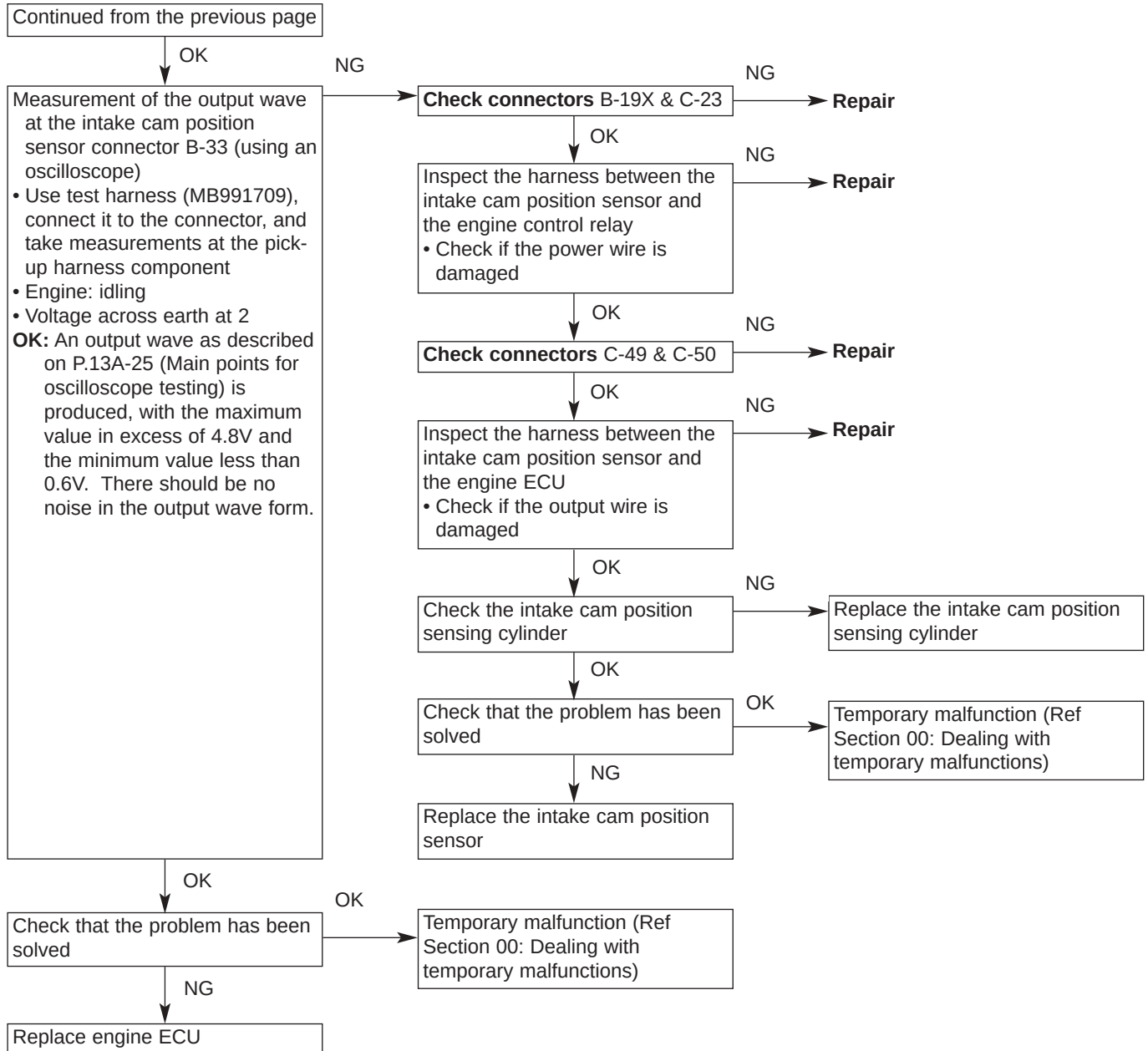
Code No.P0340 Exhaust cam position sensor system	Probable cause of the malfunction
Conditions for inspection • Ignition switch: ON • With engine cranking or running Evaluation conditions • The sensor output voltage does not change for 4 seconds (with no input of pulse signals)	• Malfunction of the exhaust cam position sensor • Broken circuit or short circuit in the exhaust cam position sensor circuit, or poor connector contact • Malfunction of engine ECU



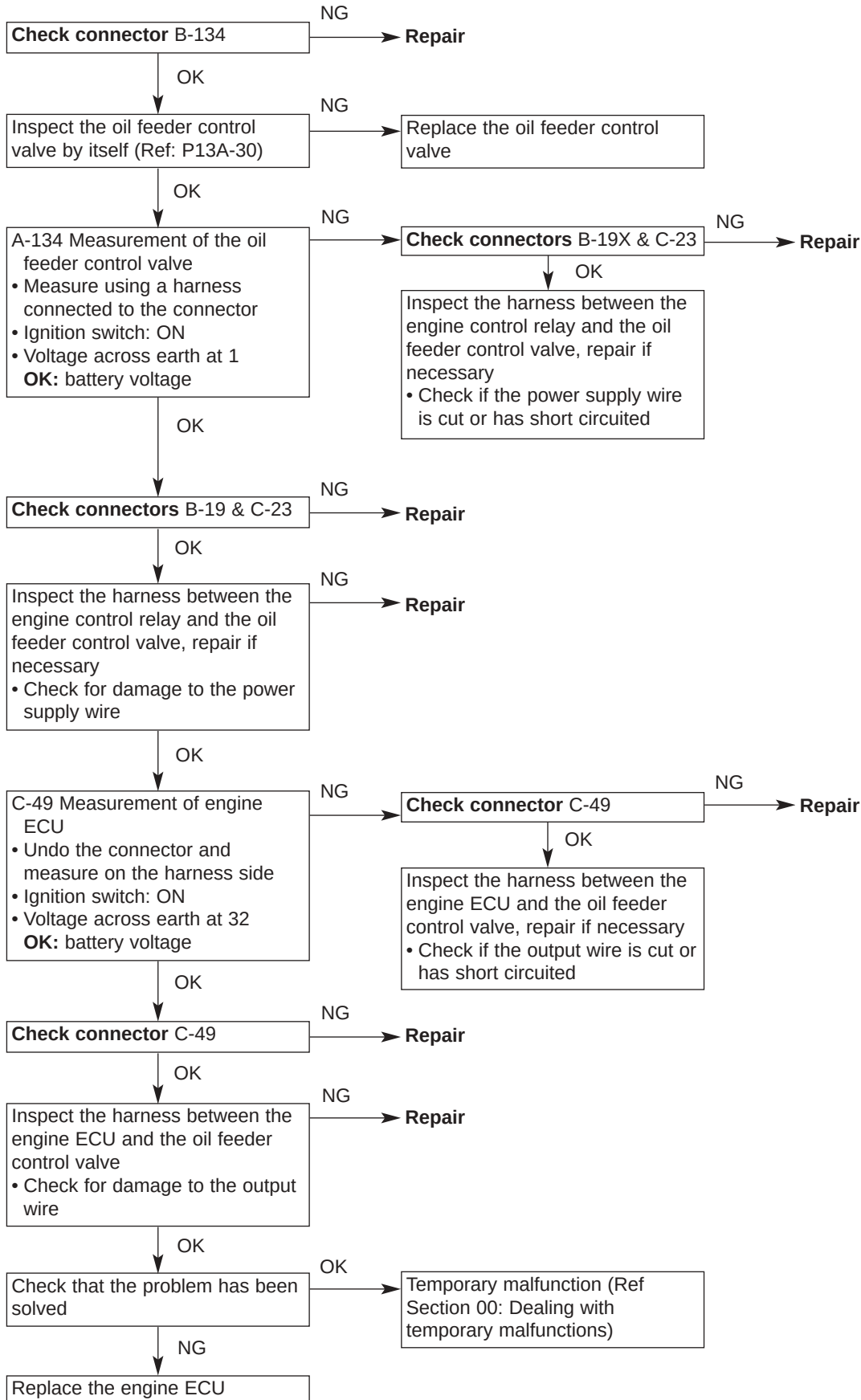


Code No.P1012 Intake cam position sensor system	Probable cause of the malfunction
Conditions for inspection • With engine cranking or running Evaluation conditions • Sensor output voltage does not change for 4 seconds (with no input of pulse signals)	• Malfunction of the intake cam position sensor • Broken circuit or short circuit in the intake cam position sensor circuit, or poor connector contact • Malfunction of engine ECU

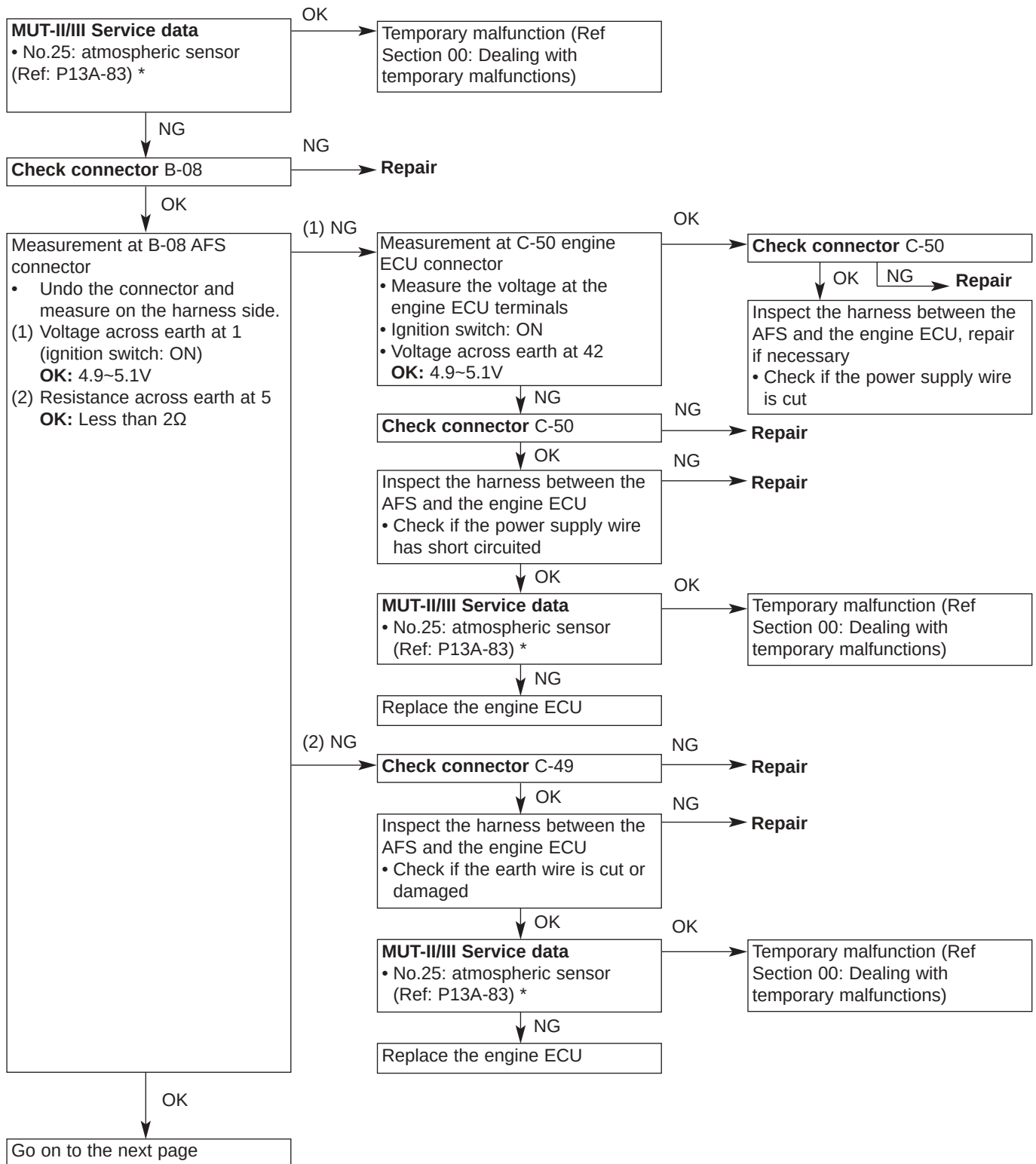




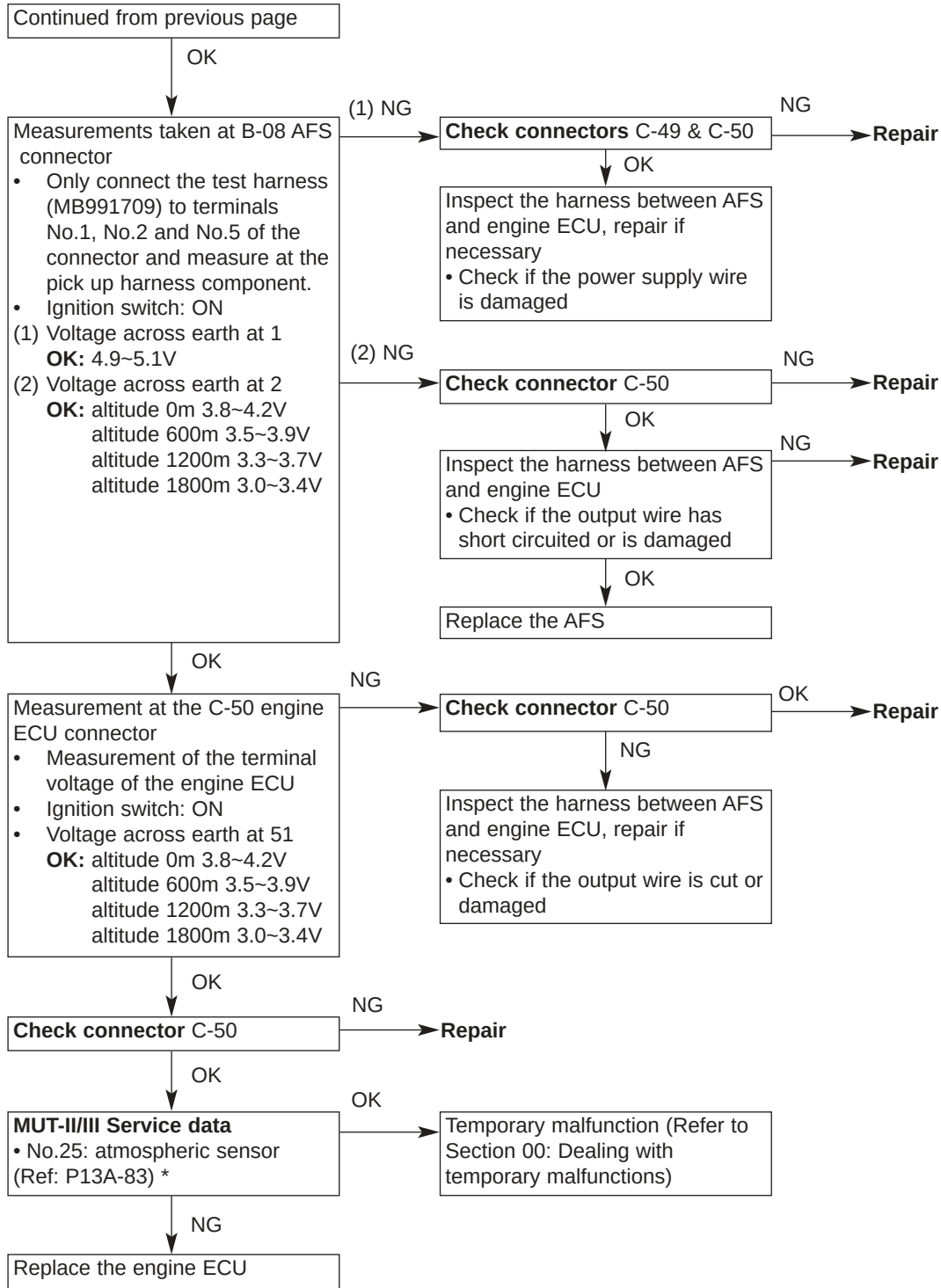
Code No.P1021 Oil feeder control valve system	Probable cause of the malfunction
Conditions for inspection - Oil feeder control valve: OFF Evaluation conditions - Operational terminal voltage of the oil feeder control valve in the ECU is abnormal for 4 seconds	- Malfunction of the oil feeder control valve - Broken circuit or short circuit in the oil feeder control valve circuit, or poor connector contact - Malfunction of engine ECU



Code No.P2226 Atmospheric pressure sensor system	Probable cause of the malfunction
Conditions for inspection - Ignition switch: ON - Wait for 2 seconds after the ignition switch has been turned on or the engine has started. Evaluation conditions - Output voltage from the sensor is more than 4.5V (when atmospheric pressure is in excess of 114kPa) for 4 seconds. Or, - Output voltage from the sensor is more than 0.2V (when atmospheric pressure is less than 5kPa) for 4 seconds.	- Malfunction of the atmospheric pressure sensor - Broken circuit or short circuit in the atmospheric pressure sensor circuit, or poor connector contact - Malfunction of engine ECU



*: Refer to the 03-1 Service Manual for the Lancer Evolution VIII (No.1036K07)



*: Refer to the 03-1 Service Manual for the Lancer Evolution VIII (No.1036K07)

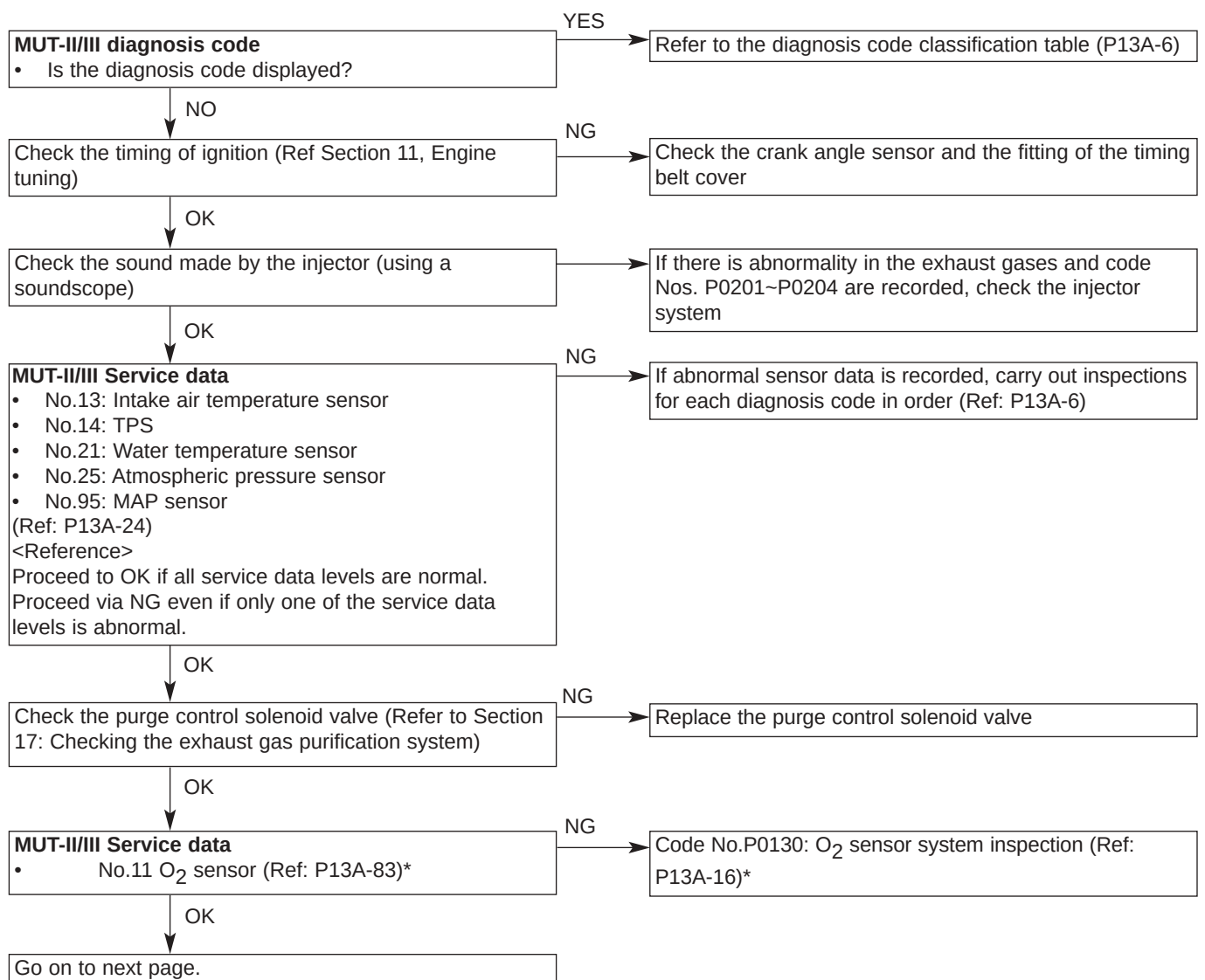
4. Checklist of faults

Inspection procedure	Fault to be checked	Reference page
11	Engine seems hesitant	13A-16
	Acceleration malfunction	
	Engine seems to stumble	
	Engine has a power surge	
15	Mis-timed ignition	13A-18
35	Inter-cooler water spray circuit system	13A-19
37	No.2 waste gate solenoid valve system	13A-21
38	Air temperature sensor system	13A-22

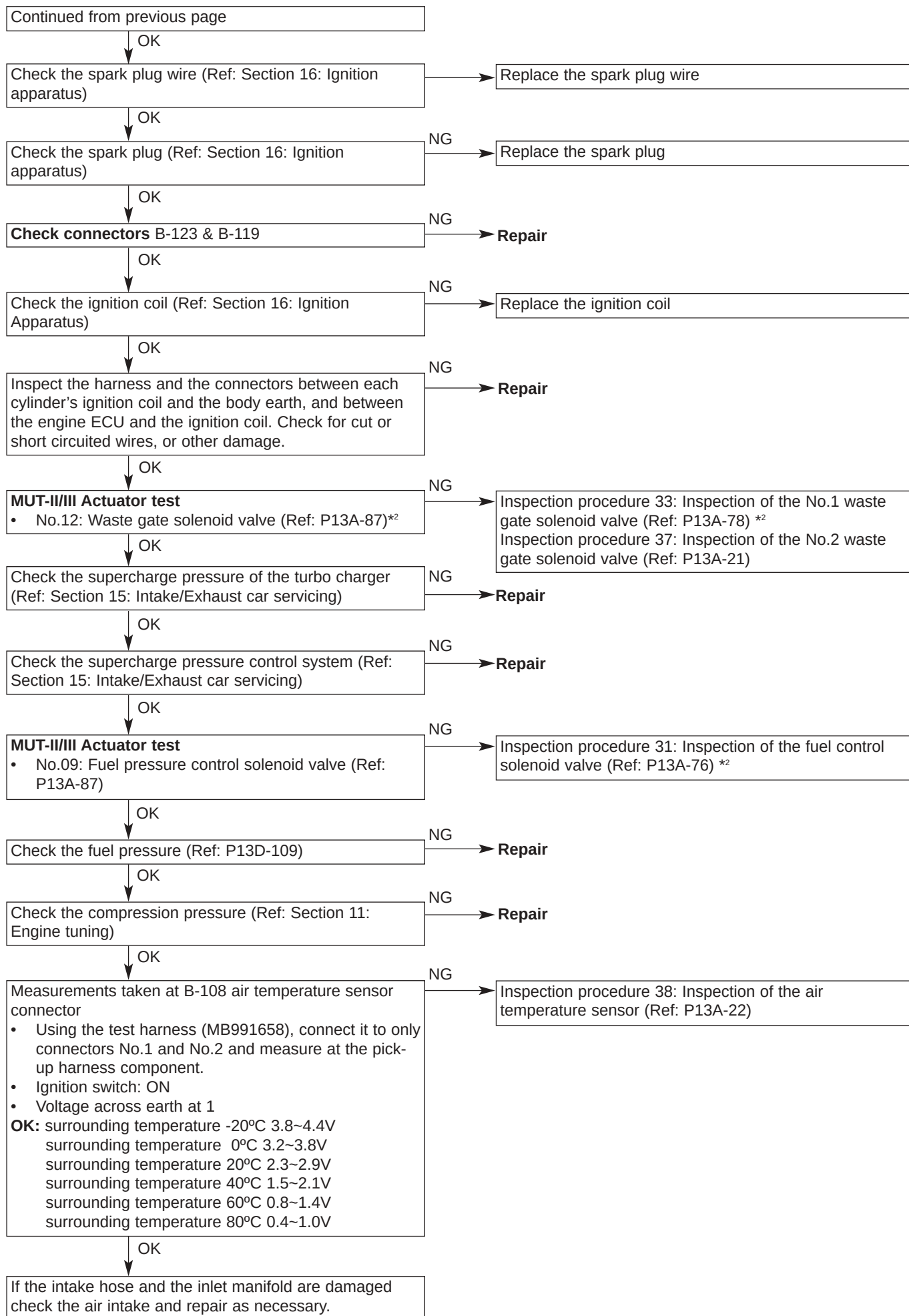
5. Inspection procedure for each type of fault

Inspection procedure 11

Engine seems hesitant, acceleration malfunction, engine seems to stumble, engine has a power surge	Probable causes of the malfunction
Probable causes of the malfunction are noted in the right hand column.	• Malfunction of the air/fuel mixing control system • Malfunction of the ignition system • Malfunction of the fuel system • Malfunction of the intake system • Malfunction of the exhaust gas purification system • Failure of compression pressure • Malfunction of the turbocharger system



*: Refer to the 03-1 Service Manual for the Lancer Evolution VIII (No.1036K07)

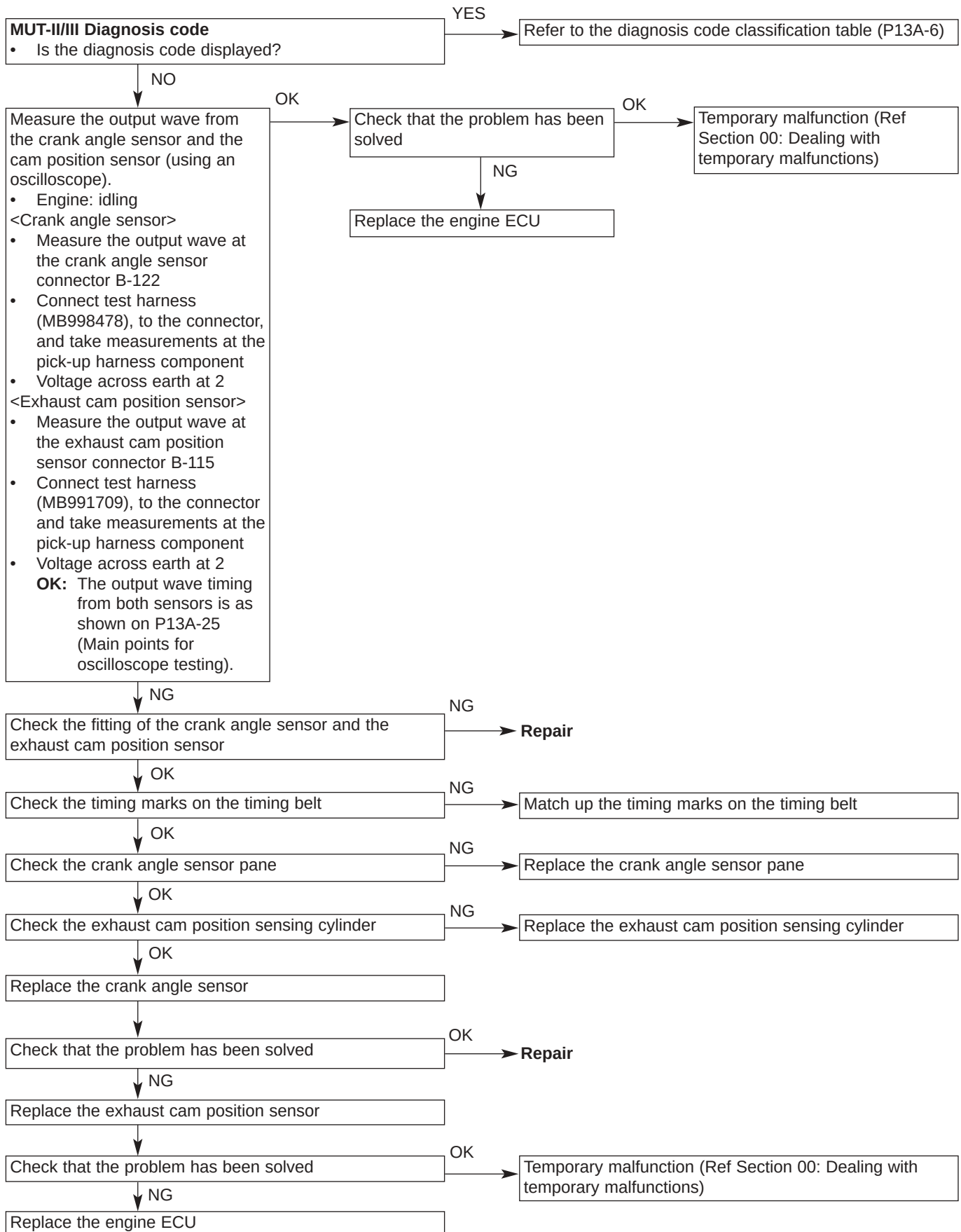


*: Refer to the 01-1 Service Manual for the Lancer Evolution VIII (No.1036K02)

*: Refer to the 03-1 Service Manual for the Lancer Evolution VIII (No.1036K07)

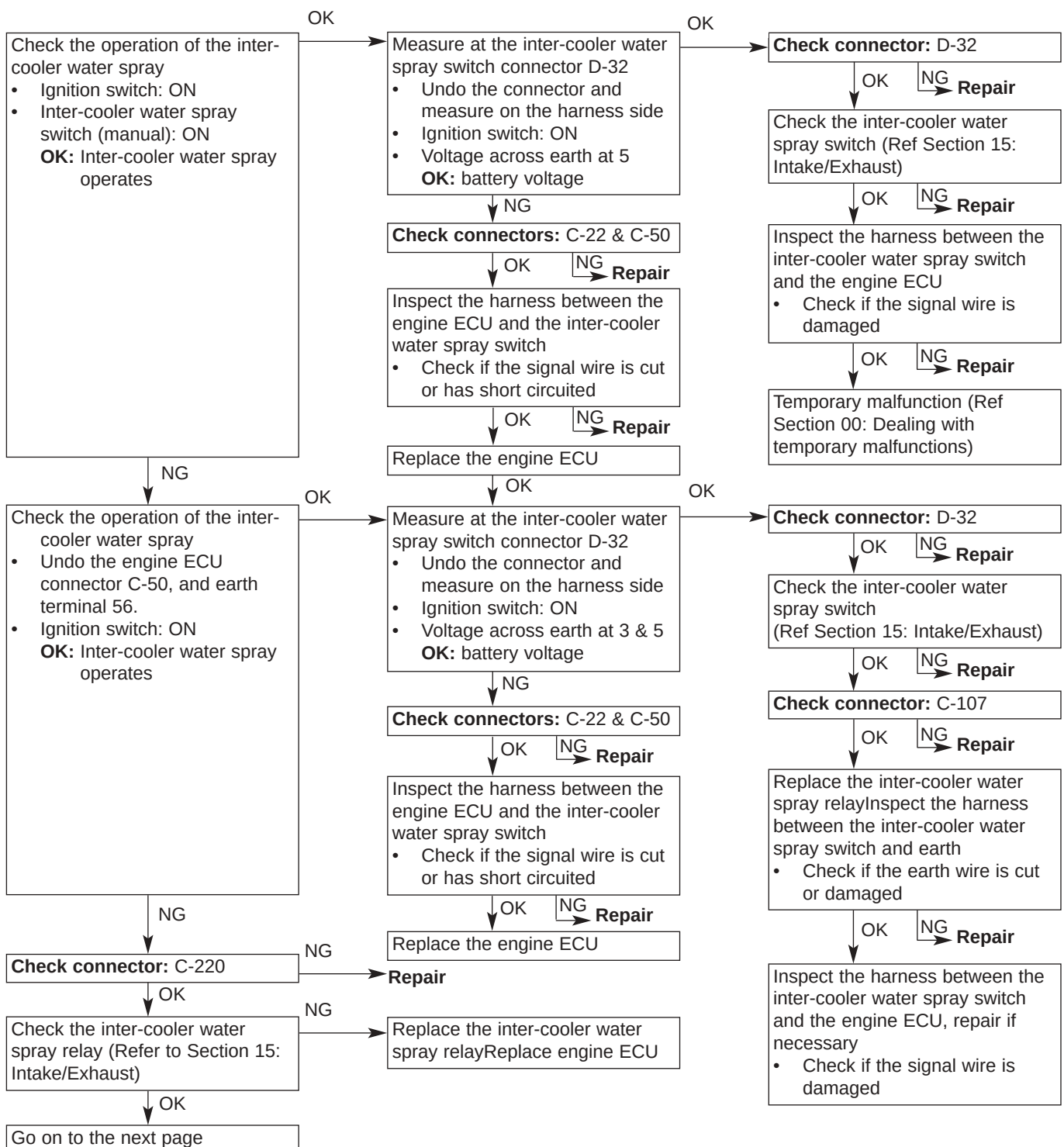
Inspection procedure 15

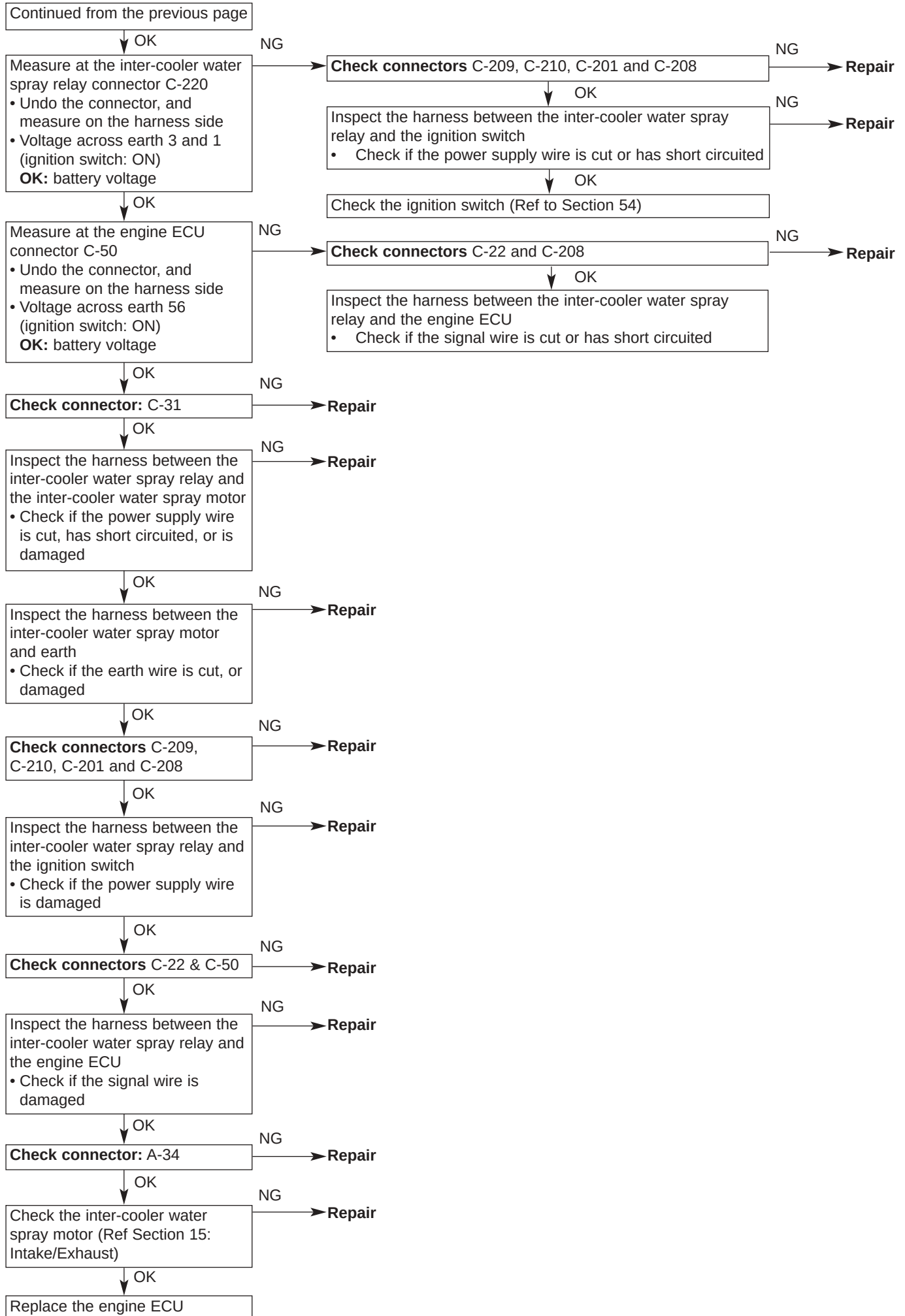
Miss-timed ignition	Probable causes of the malfunction
Probable causes of the malfunction are noted in the right hand column.	• Malfunction of the crank angle sensor • Malfunction of the exhaust cam position sensor • Malfunction of the timing belt • Malfunction of the engine ECU



Inspection procedure 35

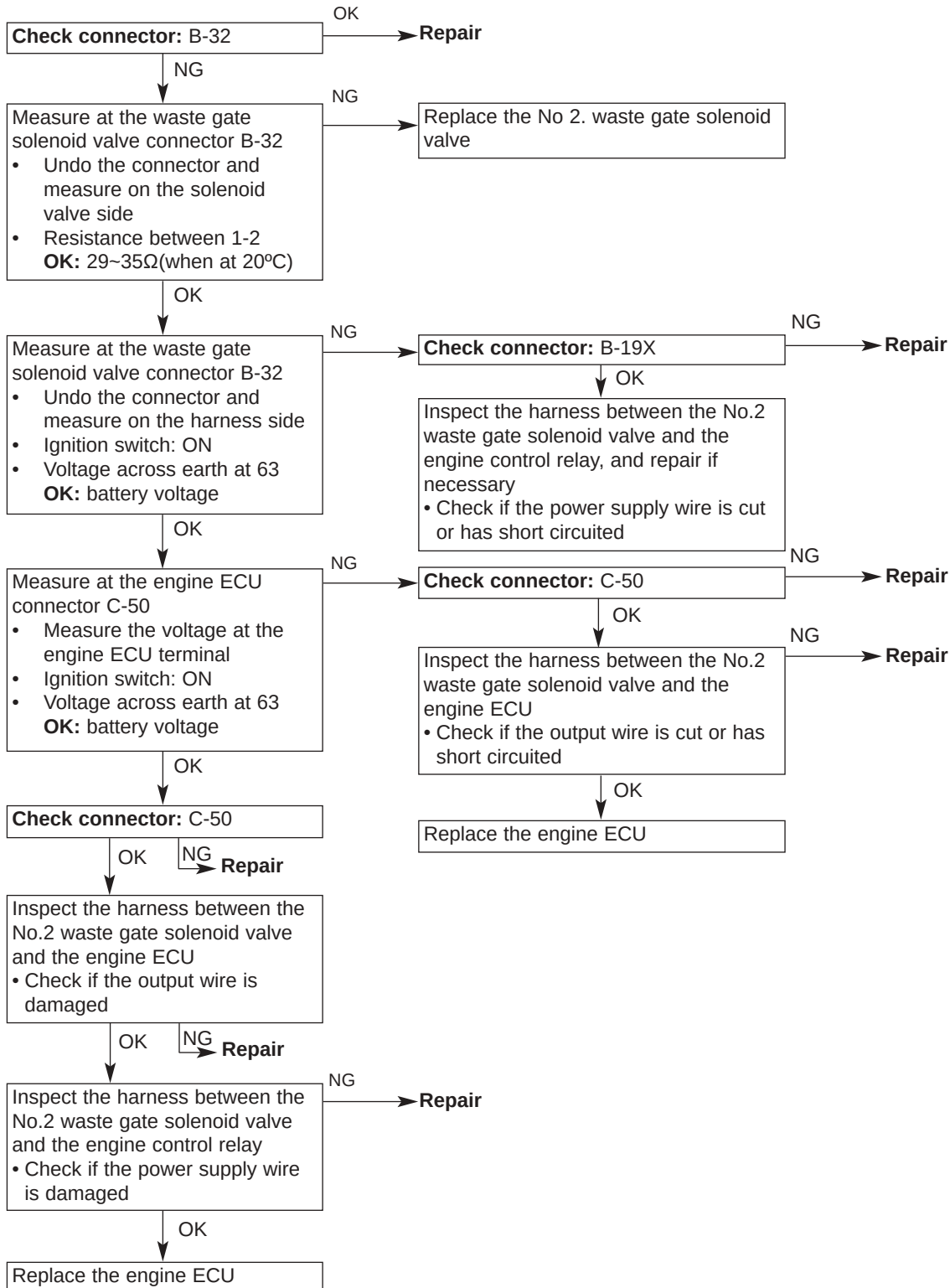
Inter-cooler water spray circuit system	Probable causes of the malfunction
- If the inter-cooler water spray switch (manual) is turned ON, the inter-cooler water spray manual 'ON' signal will be input in the engine ECU. When this signal is received, the engine ECU will turn the inter-cooler water spray relay ON, and will start the inter-cooler water spray motor. Water will be sprayed into the inter-cooler to cool intake air, and filling efficiency will improve. - If the inter-cooler water spray switch (auto) is turned ON, the inter-cooler water spray auto 'ON' signal will be input in the engine ECU. When this signal is received the engine ECU will intermittently run at a high load, it will turn the inter-cooler water spray relay ON, and it will start the inter-cooler water spray motor. Water will be sprayed into the inter-cooler to cool intake air, and filling efficiency will improve.	- Malfunction of the inter-cooler water spray switch. - Malfunction of the inter-cooler water spray relay. - Malfunction of the inter-cooler water spray motor. - Circuit break, short circuit or a faulty connection in the inter-cooler water spray relay circuit. - Circuit break, short circuit or a faulty connection in the inter-cooler water spray switch circuit. - Malfunction of the ignition switch. - Malfunction of the engine ECU.





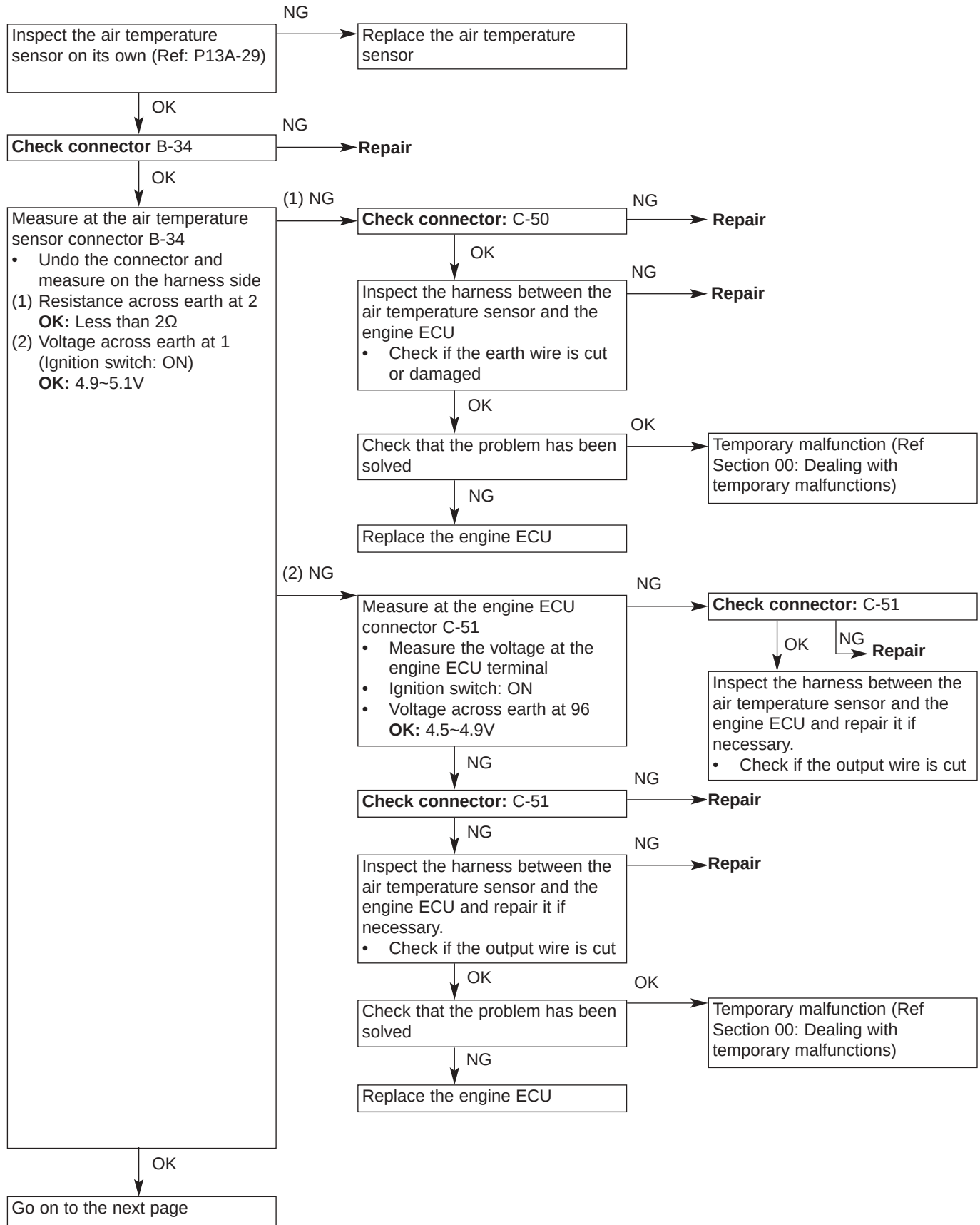
Inspection procedure 37

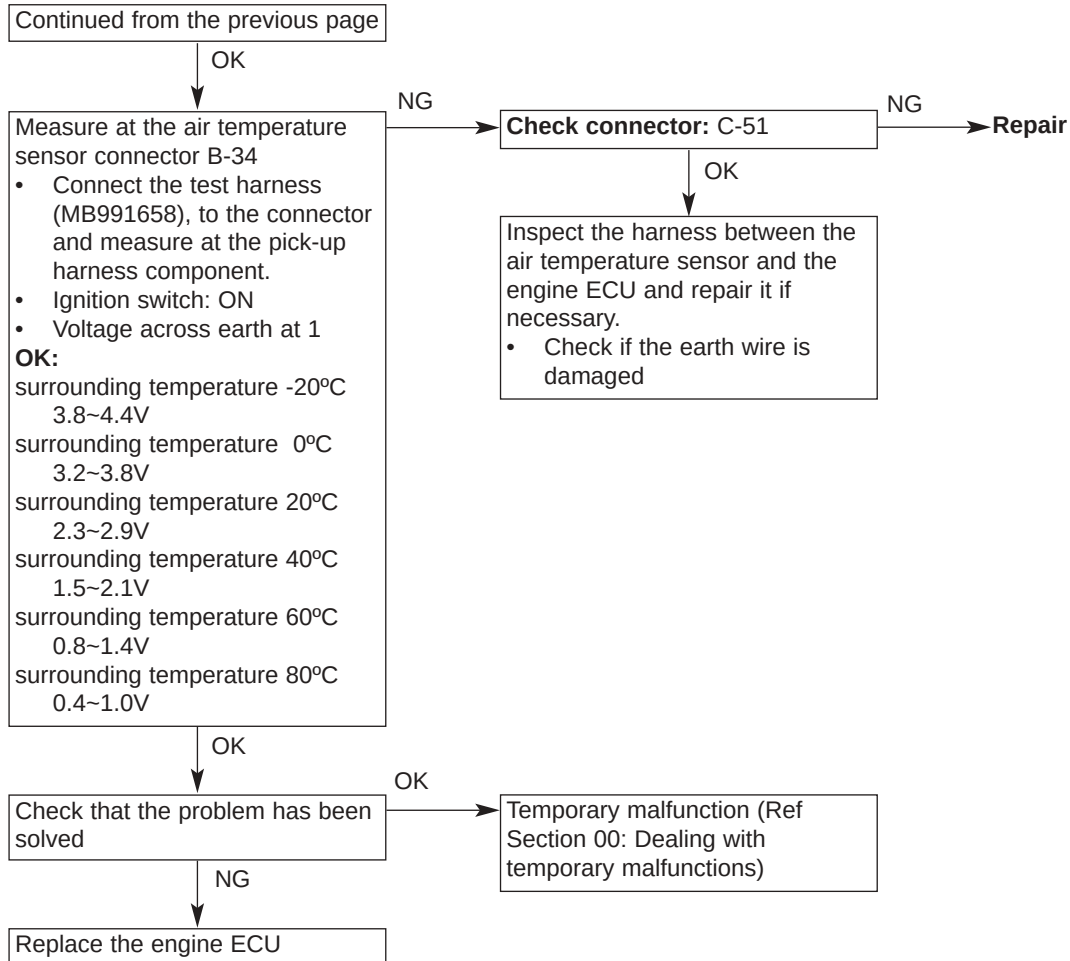
No.2 waste gate solenoid valve system	Probable causes of the malfunction
The No.2 waste gate solenoid valve controls the supercharge pressure introduced to the waste gate actuator in the turbocharger.	- Malfunction of the No.2 waste gate solenoid valve. - Circuit break, short circuit or a faulty connection in the No.2 waste gate solenoid valve circuit. - Malfunction of the engine ECU.



Inspection procedure 38

Air temperature sensor system	Probable causes of the malfunction
The air temperature sensor controls the temperature inside the inlet manifold, and compensates for any burning of fuel.	- Malfunction of the air temperature sensor. - Circuit break, short circuit or a faulty connection in the air temperature sensor circuit. - Malfunction of the engine ECU.





6. Service data table

Item No.	Items to be checked	Conditions for checking		Normal condition	Code No. or checking procedure No.	Reference page
25	Atmospheric pressure sensor	Ignition switch: ON	altitude: 0m altitude: 600m altitude: 1200m altitude: 1800m	101kPa 95kPa 88kPa 81kPa	Code No. P2226	13A-14
7E	V.V.T. phase angle	Engine: after warming up	Idle running without a load Without a load 3,000r/min	0~5°C 8~12°C	-	-
95	Manifold absolute pressure (MAP) sensor	- Engine cooling water temperature: 80~95 °C - Lights, electric cooling fan, ancillary devices: OFF - Transmission: neutral - Ignition switch: ON	Engine stopped altitude: 0m altitude: 600m altitude: 1200m altitude: 1800m Idle running Vigorous racing	101kPa 95kPa 88kPa 81kPa 31~45 kPa Changes in response to the intake manifold negative pressure	Code No. P0105	13A-7

7. Engine ECU checks

7-1 Terminal voltage table

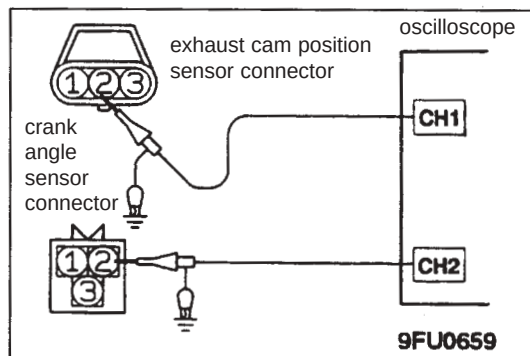
Item No.	Items to be checked	Conditions for checking (engine condition)		Normal condition
32	Oil feeder control valve	Ignition switch: ON		Battery voltage
		Running with a high load		4~10V
50	Exhaust cam position sensor	Engine: cranking		0.4~3.0V
		Engine: idle running		0.5~2.0V
53	Intake cam position sensor	Engine: cranking		0.4~3.0V
		Engine: idle running		0.5~2.0V
56	Inter-cooler spray relay	Ignition switch: ON		Battery voltage
		Ignition switch: LOCK (OFF)		Less than 1V
63	No.2 waste gate solenoid valve	Ignition switch: ON		Battery voltage
		Accelerating with two-speed throttle fully open (over 3,500r/min)		Voltage drops
92	MAP sensor	Ignition switch: ON	altitude: 0m altitude: 600m altitude: 1200m altitude: 1800m	1.2~1.8V 1.1~1.7V 1.0~1.6V 0.9~1.5V
		Engine: after warming up, idling		0.46~0.66V
		Engine: after warming up, suddenly push the accelerator when the engine is idling		Changes in response to intake manifold negative pressure
96	Air temperature sensor	Ignition switch: ON	when intake air temp is -20 °C when intake air temp is 0 °C when intake air temp is 20 °C when intake air temp is 40 °C when intake air temp is 80 °C	3.8~4.4V 3.2~3.8V 2.3~2.9V 0.8~1.4V 0.4~1.0V

7-2 Table showing resistance and continuity across the terminals of harness side connectors

Terminal number	Item to be checked	Standard value, normal condition (conditions for checking)
32-47	Oil feeder control valve	6.9~7.9Ω (when at 20 °C)
63-47	No.2 waste gate solenoid valve	29~35Ω (when at 20 °C)
96-49	Air temperature sensor	13~18kΩ (when intake air temp is -20 °C)
		5.1~6.9kΩ (when intake air temp is 0 °C)
		2.0~3.0kΩ (when intake air temp is 20 °C)
		0.9~1.5kΩ (when intake air temp is 40 °C)
		0.40~0.78kΩ (when intake air temp is 60 °C)
		0.23~0.42kΩ (when intake air temp is 80 °C)

8. Checks using an oscilloscope

Sensor output signals and actuator drive signals can be checked visually by taking waveform measurements using an oscilloscope.



8.1 Exhaust cam position sensor and the crank angle sensor

<Measurement method>

- (1) Disconnect the exhaust cam position sensor connector, and connect the special test harness (MB991709) in its place.
- (2) Disconnect the crank angle sensor connector, and connect the special test harness (MB998478) in its place.
- (3) Connect the No.2 terminal of the exhaust cam position sensor connector and the No.2 terminal (the black coloured clip on the special tool) of the crank angle sensor connector, to the probes for each channel on the oscilloscope.

Note

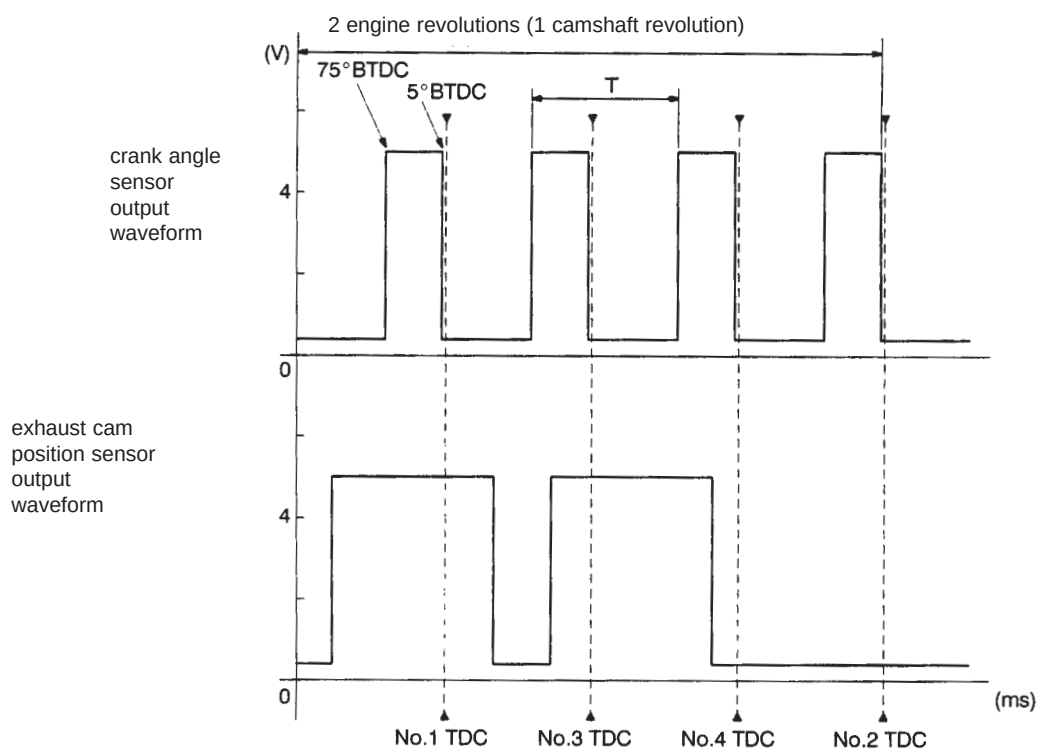
When measuring at the engine ECU connector, connect the probes for each channel on the oscilloscope to No.50 terminal (exhaust cam position sensor), and to No.43 terminal (crank angle sensor).

<Standard waveforms>

Observation conditions

	Exhaust cam position sensor	Crank angle sensor
Probe switch	X1	x1
AC-GND-DC	DC	DC
TIME/DIV.	10ms	10 ms
VOLTS/DIV.	2V	2V
Other	-	-
Engine	Idling	

Standard waveform



6FU2B03

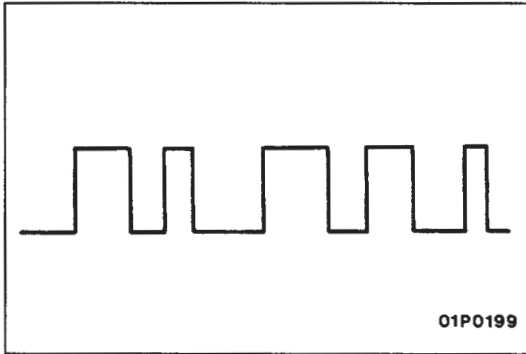
<Explanation of waveforms>

- The exhaust cam position sensor detects the compression top dead centre for each cylinder, and by simultaneous observation of these and other controlling signals, it is possible to distinguish between the cylinders.
- The crank angle sensor detects the crank angle for each cylinder. There is an output of 4 evenly spaced crank angle sensor HIGH signals for every 2 revolutions of the engine. Therefore, by measuring the cycle time (seconds), engine revolution speed can be calculated according to the following formula:

$$\text{Engine revolution speed} = \frac{2}{4T} (\text{seconds}) \times 60 = \frac{30}{T} (\text{seconds})$$

<Waveform observation points>

- Check that the cycle time gets shorter as the engine revolution speed increases.



<Examples of abnormal waveforms>

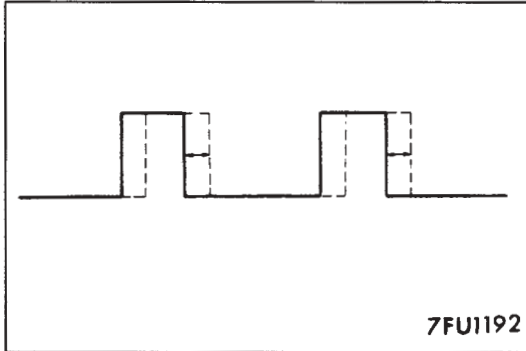
- Example 1

Waveform characteristics

A rectangular waveform is produced even though the engine has not been started.

Cause of the problem

Sensor interface fault



- Example 2

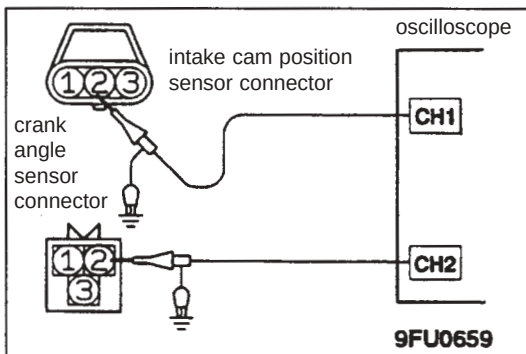
Waveform characteristics

The waveform is displaced to the left or the right.

Cause of the problem

The timing belt is loose.

There is an abnormality in the sensor disc.

**8-2 Intake cam position sensor**

<Measurement method>

- (1) Disconnect the intake cam position sensor connector and connect the special test harness (MB991709) in its place. (All terminals should be connected).
- (2) Connect the oscilloscope probe to the No.2 terminal of the intake cam position sensor connector.

Note

When measuring at the engine ECU connector, connect the No.53 terminal (intake cam position sensor) to the oscilloscope probe.

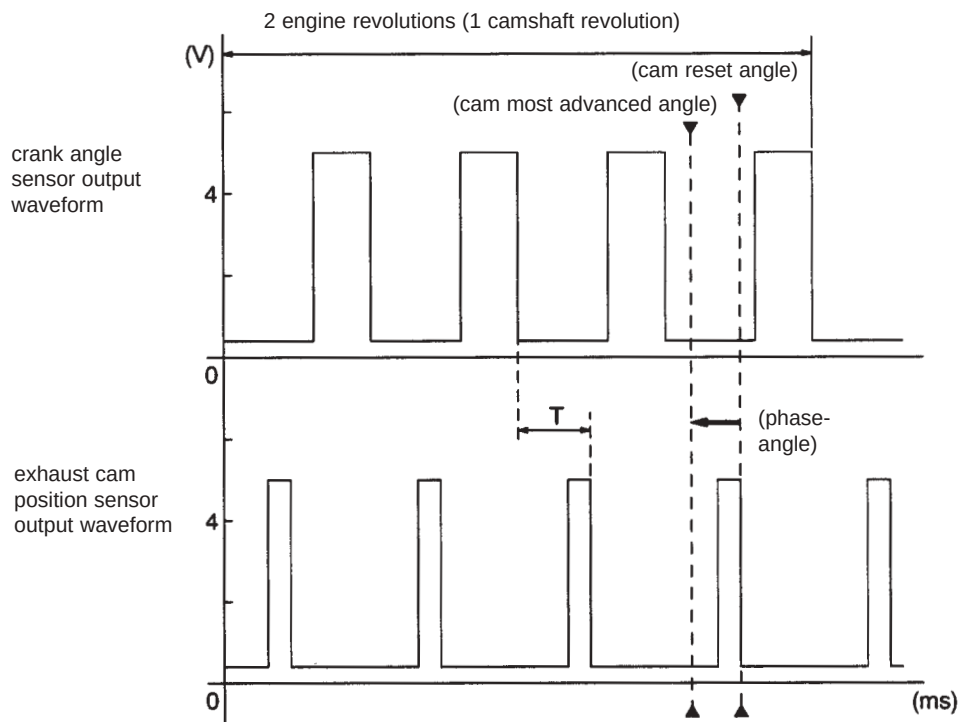
- (3) When checking the output signal of the intake cam position sensor, observe the output signal of the crank angle sensor at the same time.

<Standard waveforms>

Observation conditions

	Intake cam position sensor	Crank angle sensor
Probe switch	X1	x1
AC-GND-DC	DC	DC
TIME/DIV.	10ms	10 ms
VOLTS/DIV.	2V	2V
Other	-	-
Engine	Idling	

Standard waveform



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<Explanation of waveforms>

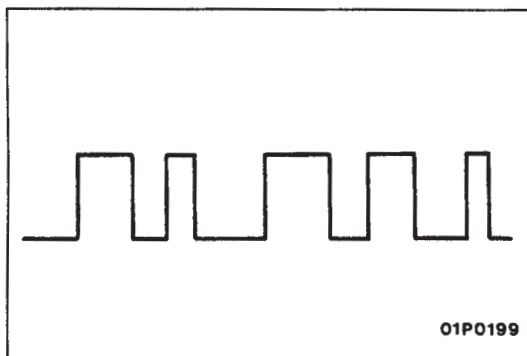
- The intake cam position sensor detects the position of the inlet camshaft. The notch located on the intake side of the camshaft creates 4 output pulses for each revolution of the camshaft.
- When the time difference between the rise and fall of the output waveform from the crank angle sensor and the rise and fall of the output waveform from the intake cam position sensor is long the cam is at the reset angle, when the time difference is short the cam is at the most advanced angle.

Note

When the cam is at the most advanced angle, the rise and fall of the output waveform from the intake cam position sensor should be at an advancing angle of about 60°.

<Waveform observation points>

- As engine revolutions approach 2500r/min, check that the time difference (T) between the rise and fall of the output waveform from the crank angle sensor, and the rise and fall of the output waveform from the intake cam position sensor, gets shorter.



<Examples of abnormal waveforms>

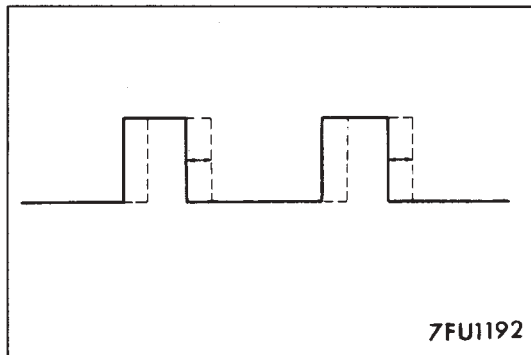
- Example 1

Waveform characteristics

A rectangular waveform is produced even though the engine has not been started.

Cause of the problem

Sensor interface fault



- Example 2

Waveform characteristics

The waveform is displaced to the left or the right.

Cause of the problem

The timing belt is loose

There is an abnormality in the fuel pump camshaft

On-vehicle servicing

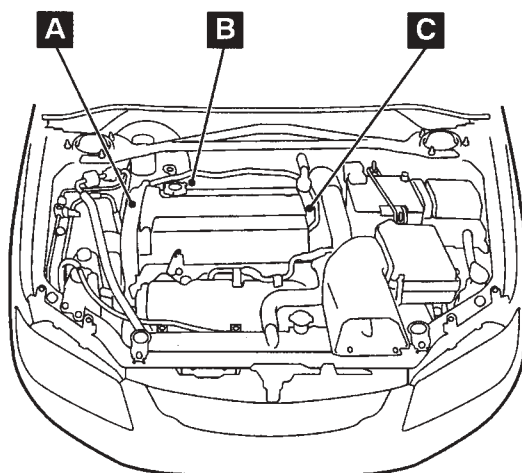
1. Adjusting standard engine revolutions when idling

The standard engine revolutions when idling have been changed. All other servicing requirements are the same as before.

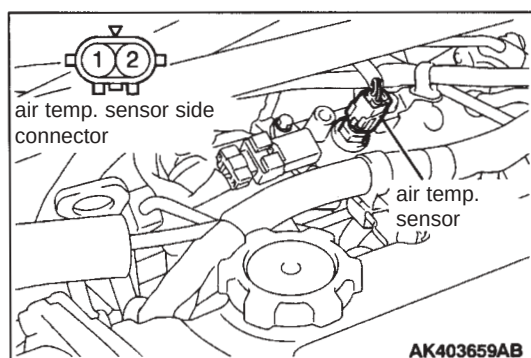
Standard engine revolutions when idling: 800 ± 50 r/min

2. Layout diagram for MPI system components

Name	Code	Name	Code
Intake cam position sensor	C	Oil feeder control valve	A
Air temperature sensor	B	Manifold absolute pressure sensor	B
Exhaust cam position sensor	C		



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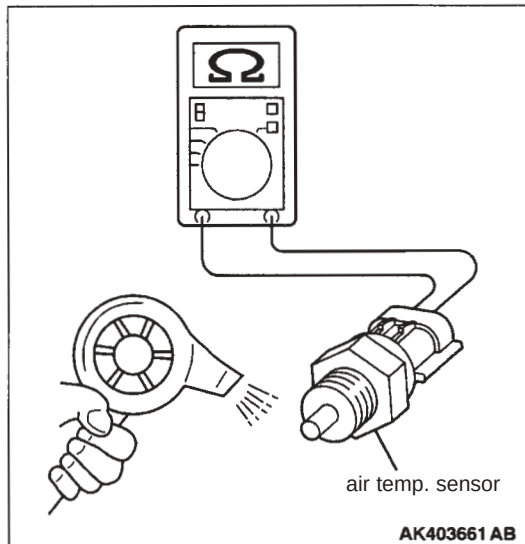
3. Inspection of the air temperature sensor

- (1) Disconnect the air temperature sensor connector.
- (2) Measure the resistance across the terminals of the air temperature sensor connector.

Standard values:

13~18 k Ω (when at -20 °C)
 5.1~6.9 k Ω (when at 0 °C)
 2.0~3.0 k Ω (when at 20 °C)
 0.9~1.5 k Ω (when at 40 °C)
 0.40~0.78 k Ω (when at 60 °C)
 0.23~0.42 k Ω (when at 80 °C)

- (3) Remove the air temperature sensor



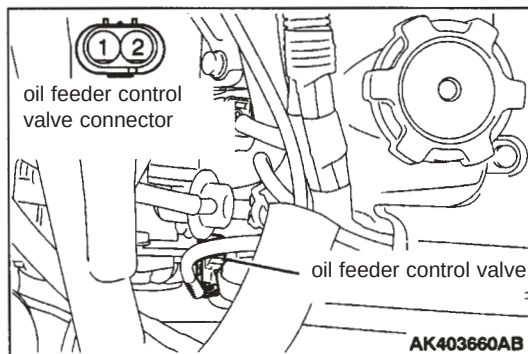
- (4) Use a hair dryer to increase the temperature and measure the resistance.

Normal conditions:

Temperature (°C)	Resistance (kΩ)
Temperature increases	Resistance decreases

- (5) If the resistance deviates from the standard values, or if it does not change, replace the air temperature sensor.
 (6) Tighten the air temperature sensor to the specified torque.

Tightening torque: $14 \pm \text{N}\cdot\text{m}$



4. Inspection of the oil feeder control valve

Checking the operation of the valve

- (1) Disconnect the oil feeder control valve connector.
- (2) Apply battery voltage across the terminals of the connector on the oil feeder control valve side, and check that the sound of the oil feeder control valve operating can be heard.

Caution

There is a chance that the coil may be damaged, so apply the voltage in as short a time as possible.

Resistance across the terminals

- (1) Remove the oil feeder control valve connector.
- (2) Measure the resistance across the terminals of the connector on the oil feeder control valve side.

Standard value: 6.9~7.9 kΩ (when at 20 °C)

- (3) If the resistance deviates from the standard value, replace the oil feeder control valve.

SECTION 14

ENGINE COOLING

CONTENTS

General.....	1	Water hose and pipe.....	3
Water pump	2		

General

The following servicing guidelines for the water pump and the water hose and pipe have been prepared for vehicles which use the 4G63-MIVEC-T/C engine. Other servicing guidelines remain unchanged.

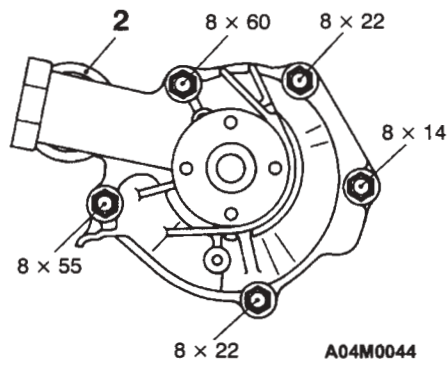
Water pump

Removal and fitting

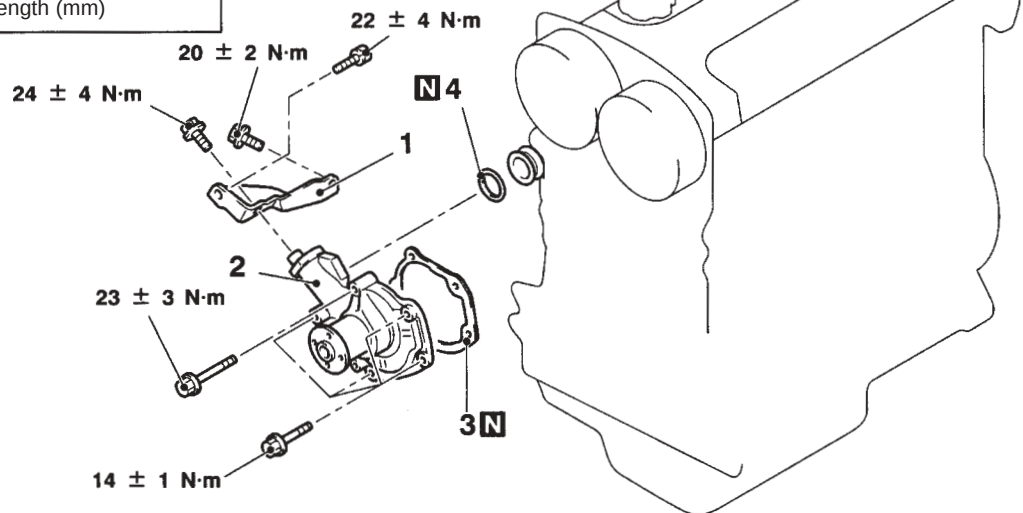
Jobs to be completed before removal and after fitting

- Draining and refilling of the coolant
- Removal and refitting of the timing belt (Ref Section 11)

Positions for fitting different sized bolts



Nominal diameter and nominal length (mm)



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Removal procedure

1. Alternator bracket
2. Water pump
3. Water pump gasket
- ▶ A ◀ 4. O-ring

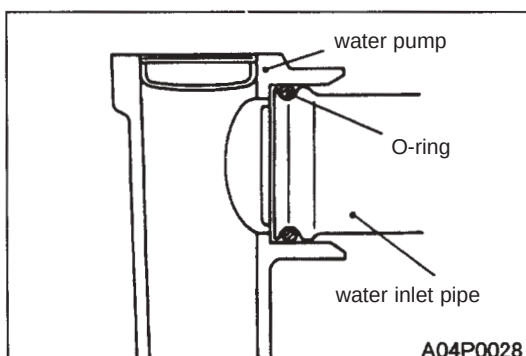
Fitting guidelines

▶ A ◀ Fitting the O-ring

Fit the O-ring into the O-ring groove at the end of the water inlet pipe, and insert it into the water pump after moistening with water the places where the O-ring will make contact with the water pump.

Caution

Ensure that absolutely no engine oil, or other type of grease, gets onto the O-ring.

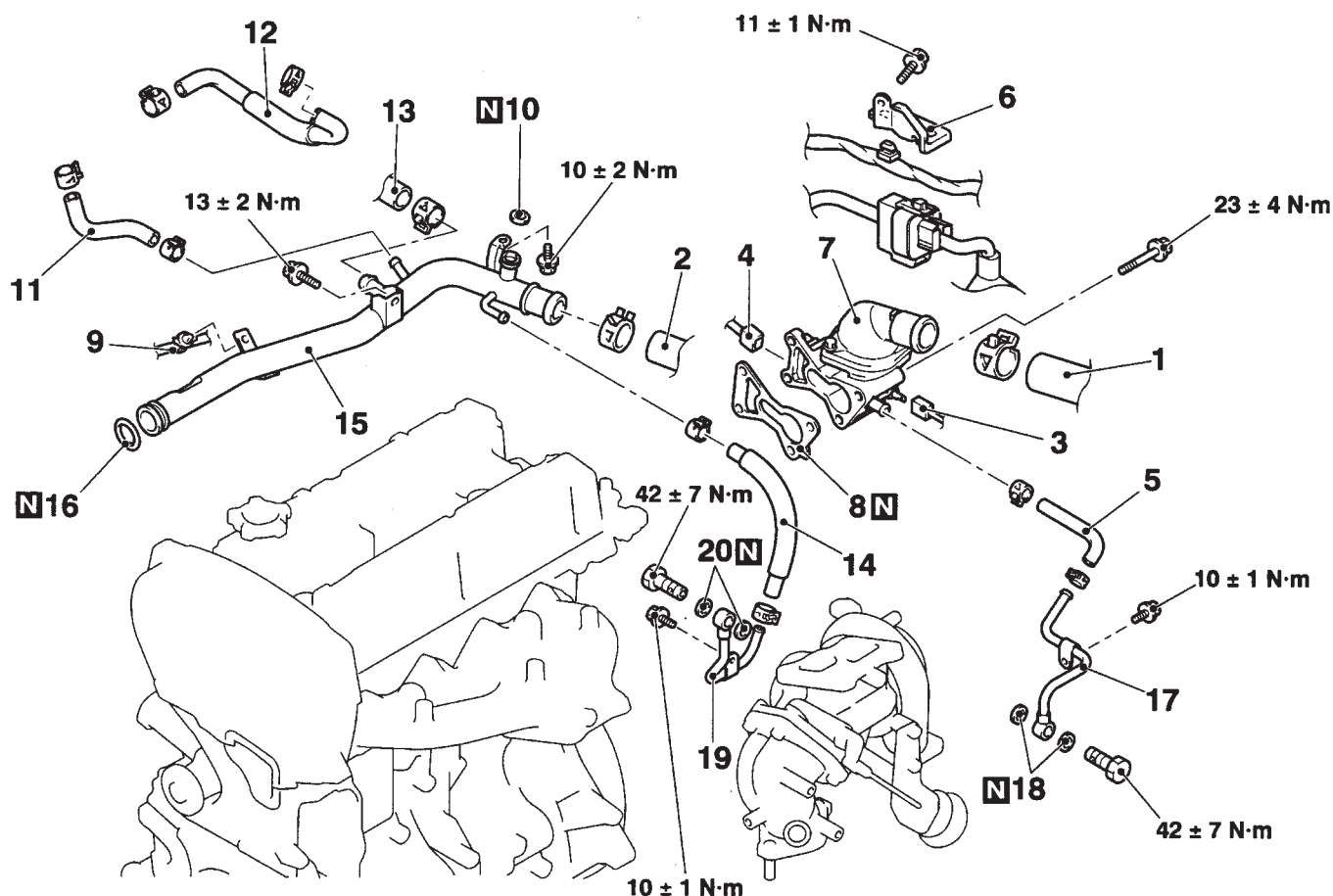


Water hose and pipe

Removal and fitting

Jobs to be completed before removal and after fitting

- Removal and refitting of the valence
- Draining and refilling of the water coolant
- Removal and refitting of the air cleaner ASSY
- Removal and refitting of the air by-pass valve ASSY, the air by-pass hose, air hoses D and E, and air pipe C
- Removal and refitting of the secondary air control valve (Ref Section 15: Secondary air control system)

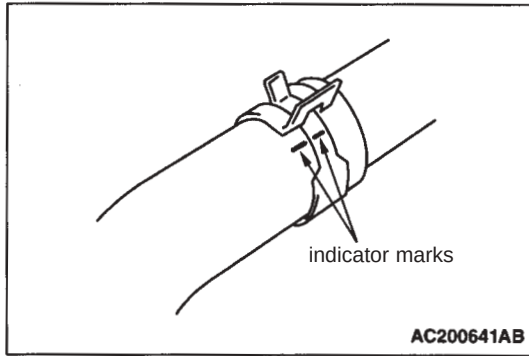


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Removal procedure

- ◀ A ▶ ▶ B ◀ 1. Connection to the radiator upper hose
- ◀ A ▶ ▶ B ◀ 2. Connection to the radiator lower hose
3. Water temperature gauge unit connector
4. Water temperature sensor connector
5. Water hose
6. Bracket
7. Water outlet fitting and thermostat case ASSY
8. Thermostat case gasket
9. Connection to the knock sensor harness clamp
- ▶ A ◀ 10. O-ring
- ▶ A ◀ 11. Water hose

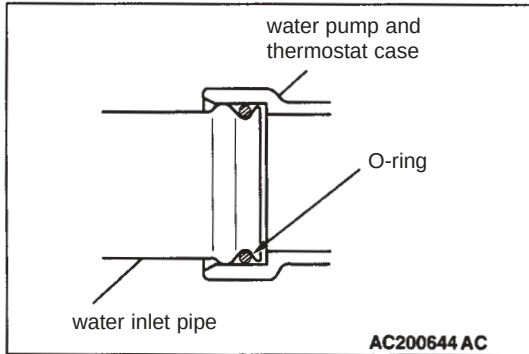
12. Water hose
13. Connection to the heater hose
14. Water hose
- ▶ A ◀ 15. Water inlet pipe
- ▶ A ◀ 16. O-ring
17. Turbocharger water feed pipe
18. Gasket
- Turbocharger ASSY
19. Turbocharger water return pipe
20. Gasket



Removal guidelines

◀ A ▶ Removing the radiator upper hose and the radiator lower hose

Mark the radiator hose and the hose clamp with indicator marks and then remove the radiator hose.



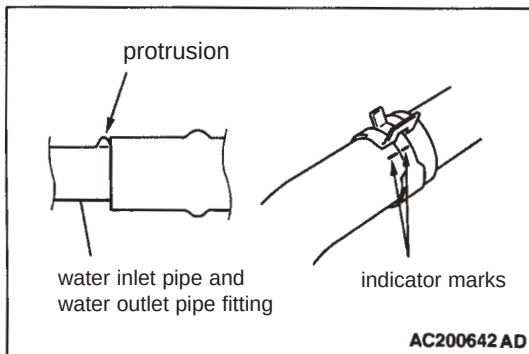
Fitting guidelines

▶ A ◀ Fitting the O-ring and the water inlet pipe

Fit the O-ring into the groove at the end of the water inlet pipe, and insert it after moistening with water the places where the O-ring and the water inlet pipe will be in contact.

Caution

Ensure that absolutely no engine oil, or other type of grease, gets onto the O-ring.



▶ B ◀ Connecting the radiator lower hose and the radiator upper hose

1. Insert the hose as far as the protrusion on the water inlet pipe and the water outlet fitting.
2. Match up the indicator marks on the radiator hose and the hose clamp, and fit the radiator hose.

SECTION 15

INTAKE & EXHAUST

CONTENTS

General.....	1	Inter-cooler water spray.....	2
Servicing standards	1	Secondary air control system	4
Special tools.....	1	Inlet manifold	5
On-vehicle servicing.....	1	Exhaust manifold and turbocharger.....	8
Turbocharger super charging pressure check	1		

General

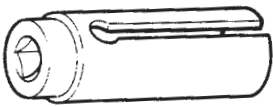
The following servicing guidelines have been prepared for vehicles which use the 4G63-MIVEC-T/C engine. Other servicing guidelines remain unchanged.

- Changes to the turbocharger supercharging pressure
- Changes to the inter-cooler water spray hose
- Changes to the secondary air control valve
- Changes to the inlet manifold
- Changes to the exhaust manifold and the turbocharger

Servicing standards

Item	Standard value
Turbocharger charging pressure kPa	97~157

Special tools

Tool	Number	Name	Function
	MD998770	O ₂ sensor wrench	Removal and fitting of the O ₂ sensor

On-vehicle servicing

Turbocharger supercharging pressure check

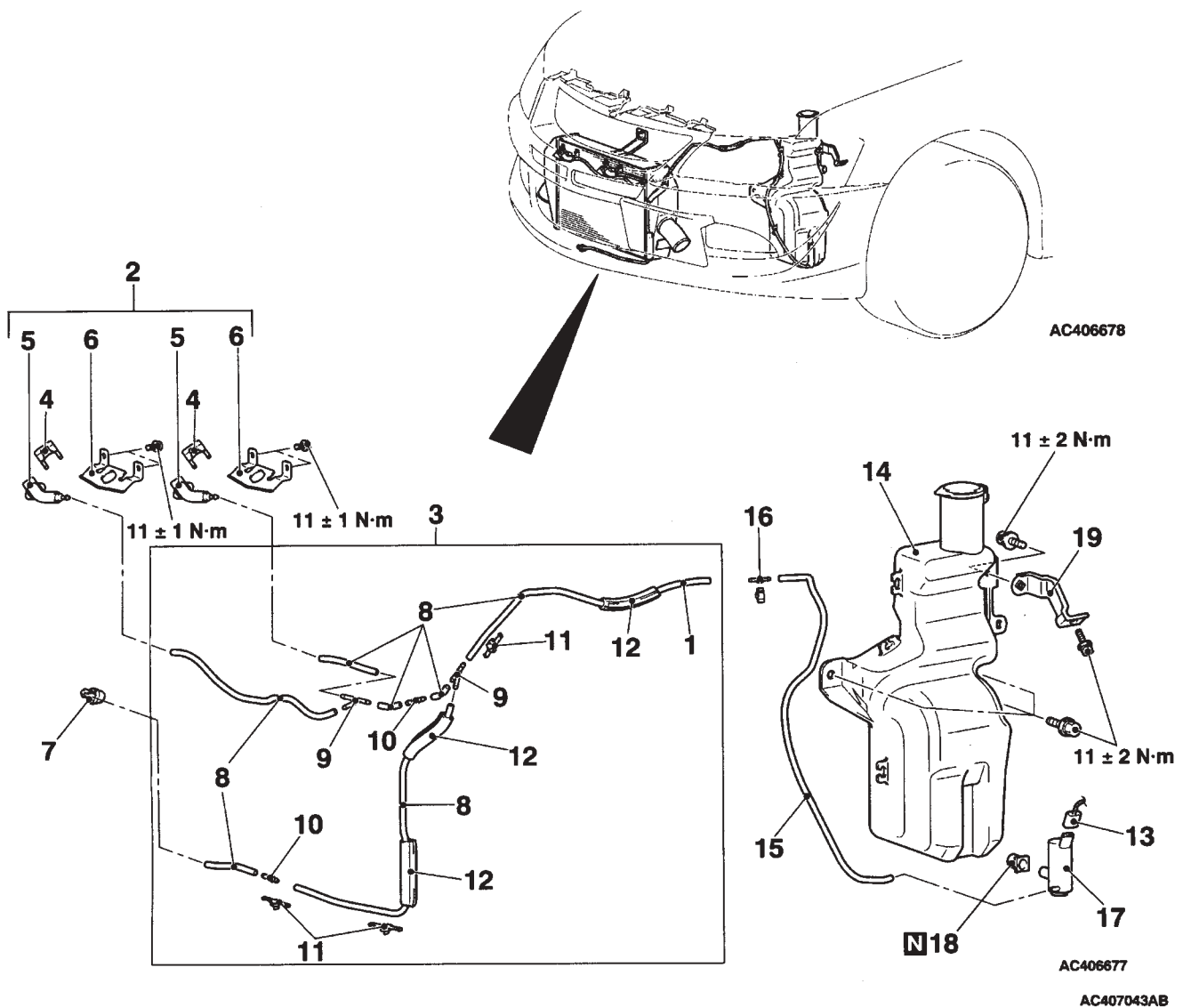
The standard value for the turbocharger charging pressure has been changed. Other servicing guidelines remain unchanged.

Standard value: 97 ~ 157 kPa

Inter-cooler water spray

Removal and fitting

<Water spray nozzle, hose and washer tank>



Procedure for removing the water spray nozzle and the hose

1. Water spray hose connection
 - Front bumper ASSY (Ref: Section 51)
- ▶ A ◀ 2. Water spray nozzle bracket
 - Tape (for fitting the water spray hose ASSY)
- ▶ A ◀ 3. Water spray hose ASSY
4. Clamp
5. Water spray nozzle (top)
6. Water spray nozzle (bottom)
7. Water spray nozzle (bottom)
8. Water spray hose
9. Three-way joint

10. Washer valve

- Tape (for attaching clip)

11. Clip

12. Pad

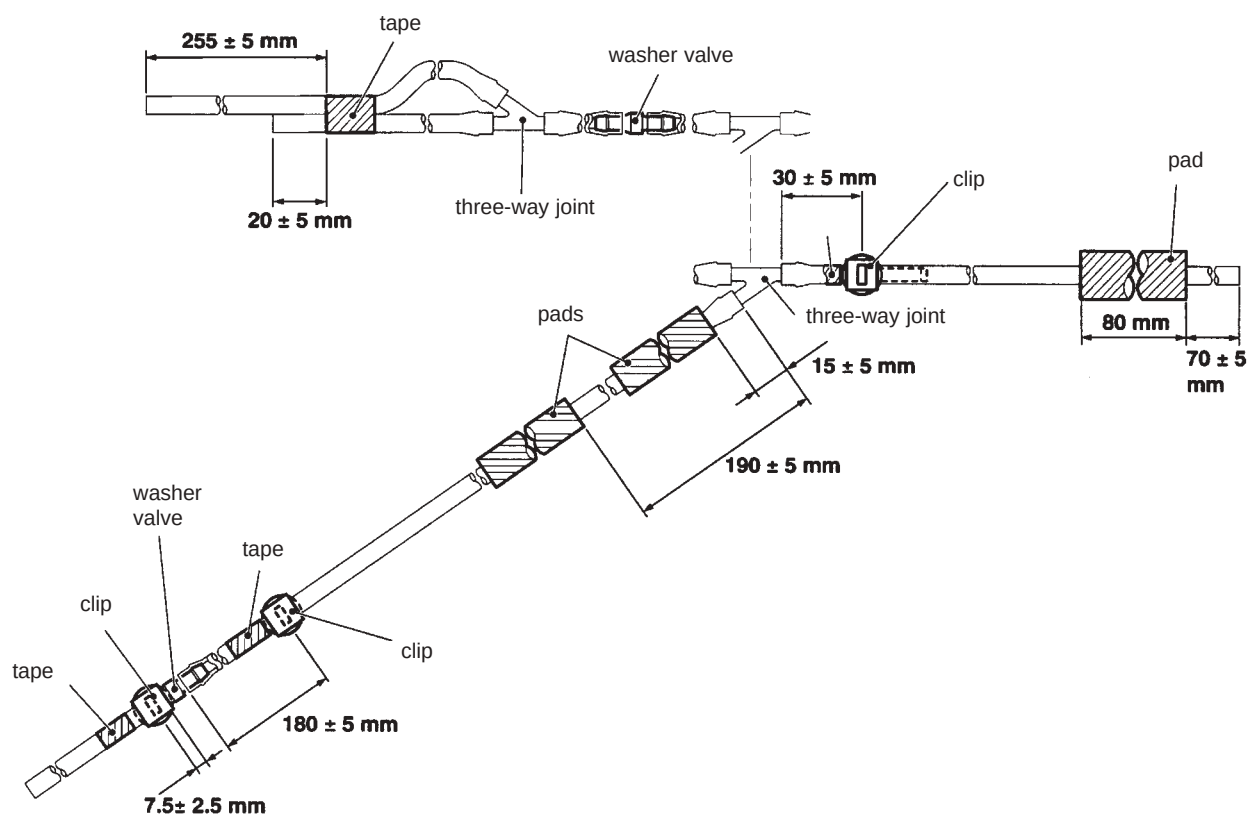
Procedure for removing the washer tank

1. Water spray hose connection
13. Water spray motor connector
14. Washer tank
15. Water spray hose
16. Washer valve
17. Water spray motor
18. Packing
19. Bracket

Fitting guidelines

► A ◀ Fitting the water spray hose ASSY and fixing tape (for securing the water spray hose ASSY)

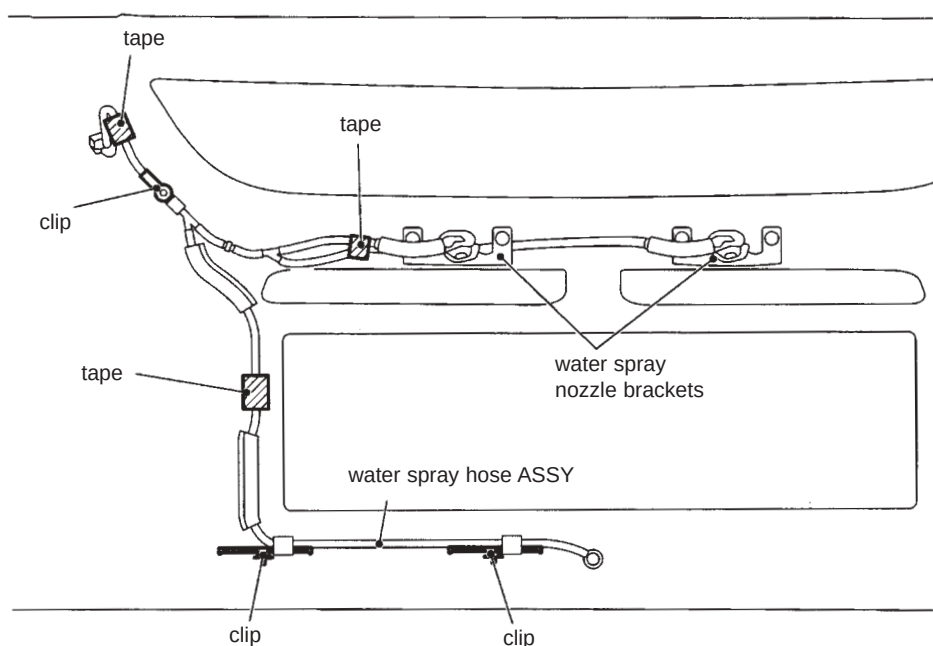
1. After fitting the water spray hose, the three-way joint and the washer valve, affix pads, clips and tape at the positions shown in the water spray hose diagram.



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2. Fit the water spray hose ASSY to the front bumper using the water spray hose ASSY clip.
3. Affix tape as shown in the diagram, so that the water spray hose ASSY does not slip.

View of the inside of the front bumper



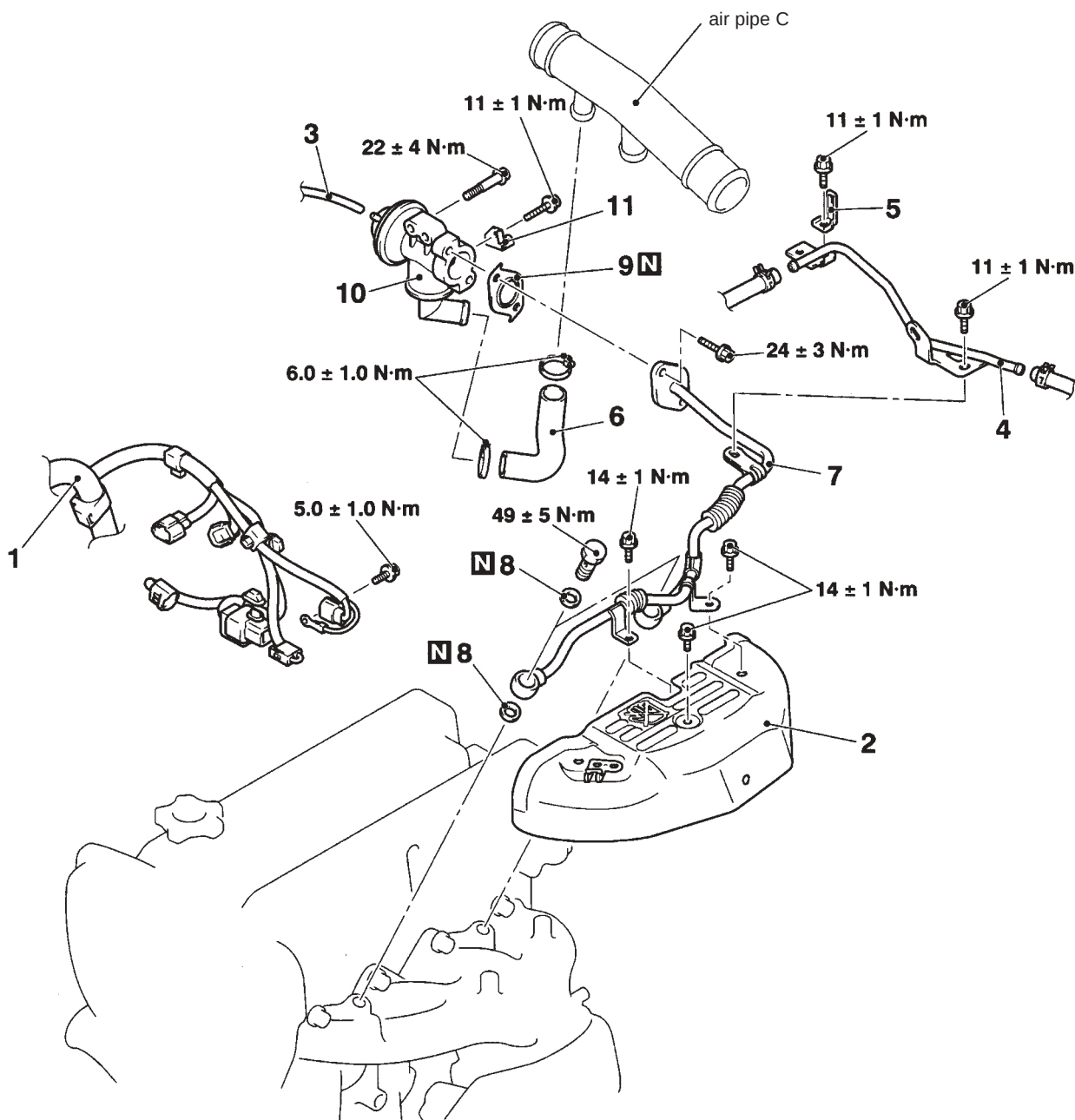
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Secondary air control system

Removal and fitting

Jobs to be completed before removal and after fitting

- Removal and refitting of the air duct
- Removal and refitting of the strut tower bar

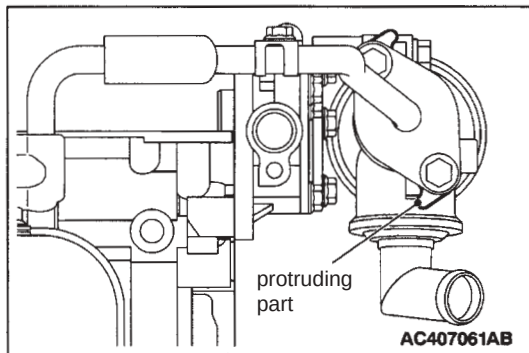


AC406679AB

Removal procedure

1. Control harness connection
2. Heat protector
3. Vacuum hose connection
 - Air pipe C
4. Vacuum pipe
5. Harness bracket

6. Air hose
7. Air pipe ASSY
8. Gasket
9. Gasket
10. Secondary air control valve
11. Harness bracket



Fitting guidelines

▶ A ◀ Fitting the gasket

Fit the gasket so that the protruding part points in the direction shown in the diagram.

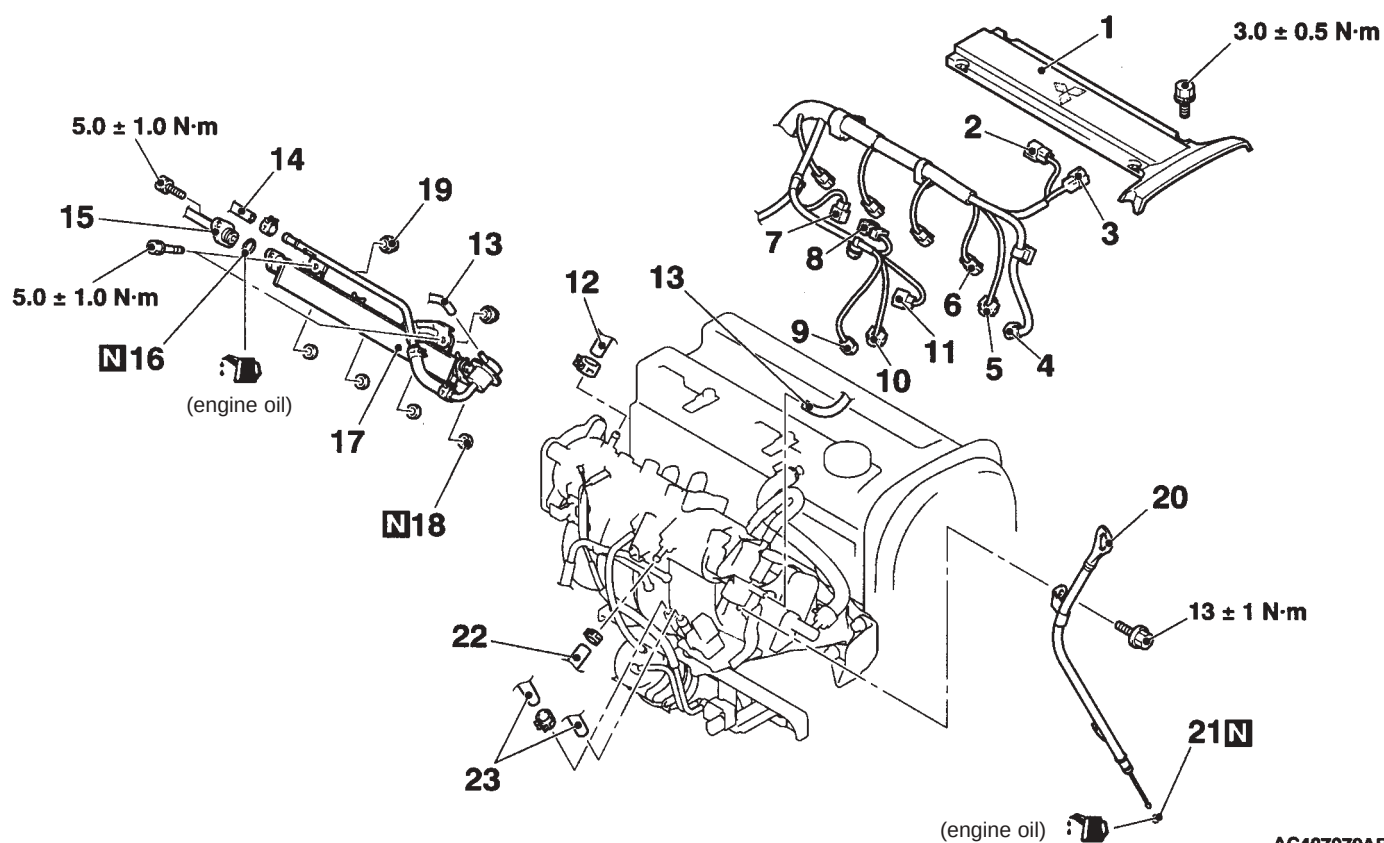
Inlet manifold

Removal and fitting

Jobs to be completed before removal and after fitting

- Take measures to prevent fuel leaking (only before removal)
- Removal and refitting of the valve (Ref Section 15: Front bumper)
- Draining and refilling the coolant
- Removal and refitting of the air duct

- Removal and refitting of the strut tower bar
- Removal and refitting of the throttle body
- Removal and refitting of the secondary air control valve (Ref P15-4)
- Removal and refitting of the cross member bar
- Removal and refitting of the front exhaust pipe



AC407070AB

Removal procedure

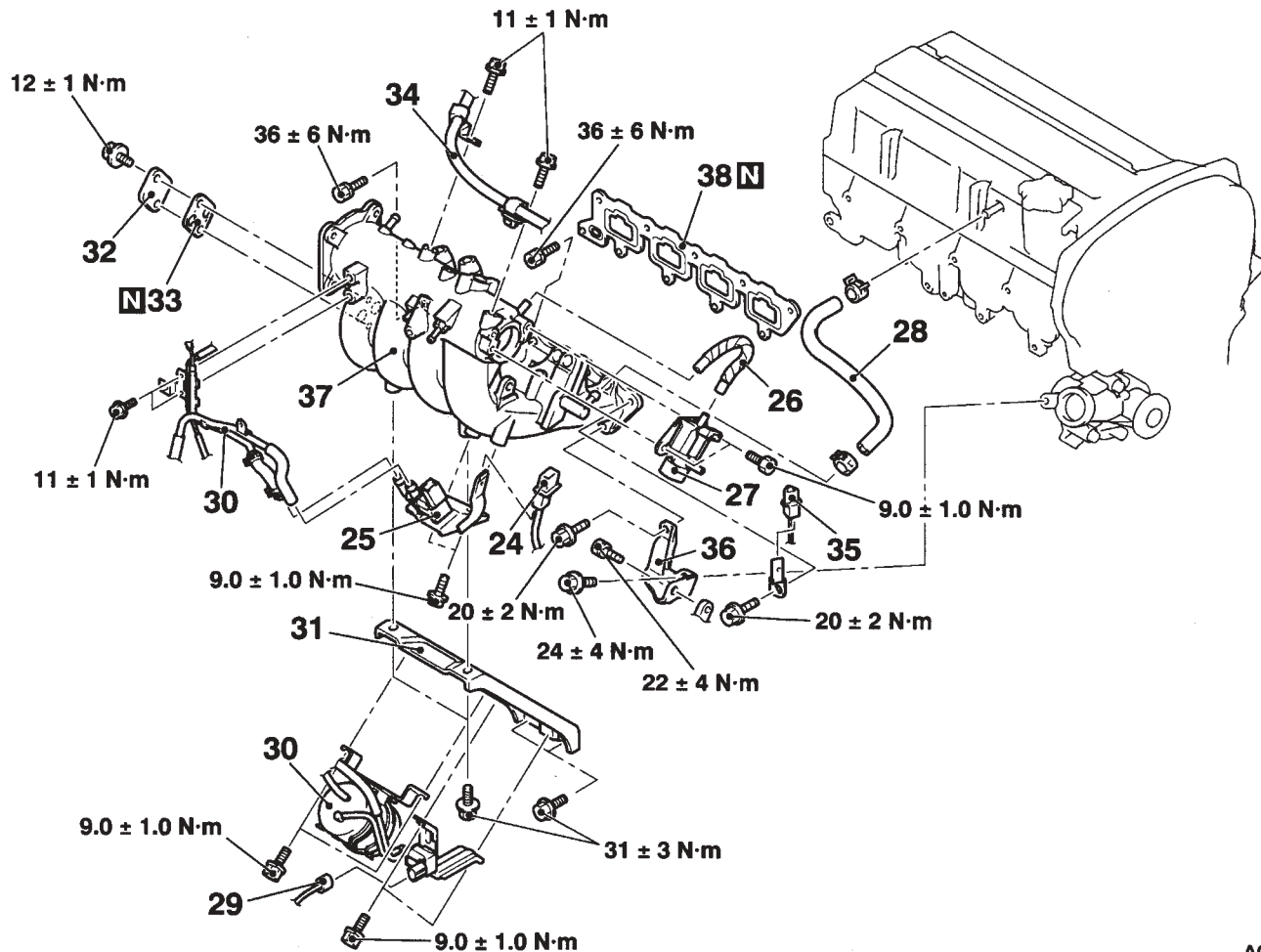
1. Centre cover
2. Ignition coil connector
3. O₂ sensor connector
4. Oil feeder control valve connector
5. Crank angle sensor connector
6. Injector connector
7. Air temperature sensor connector
8. Manifold absolute pressure sensor connector
9. Purge control solenoid valve connector
10. Knock sensor connector
11. Fuel pressure solenoid valve connector

◀ A ▶

▶ A ◀

▶ A ◀

12. Vacuum hose connection
13. Vacuum hose connection
14. Fuel return hose connection
15. Fuel high pressure hose connection
16. O-ring
17. Delivery pipe, injector and fuel pressure regulator ASSY
18. Insulator
19. Insulator
20. Oil level gauge & guide ASSY
21. O-ring
22. Brake booster vacuum hose connection
23. Purge hose connection



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Removal procedure

- | | |
|--|----------------------------------|
| 24. Knock sensor connector | 31. Inlet manifold stay |
| 25. Purge control solenoid valve ASSY | 32. Cover |
| 26. Vacuum hose | 33. Gasket |
| 27. Fuel pressure solenoid valve ASSY | 34. Harness connection |
| 28. PCV hose | 35. Crank angle sensor connector |
| • Alternator (Ref Section 16: Alternator) | 36. Alternator bracket |
| 29. Secondary air control solenoid valve connector | 37. Inlet manifold |
| 30. Vacuum tank, ACV solenoid valve, vacuum hose & pipe ASSY | 38. Inlet manifold gasket |

Removal guidelines

◀ A ▶ Removal of the delivery pipe, the injector and the fuel pressure regulator ASSY

Remove the deliver pipe, with the injector and the fuel pressure regulator intact.

Caution

When removing the delivery pipe, be careful not to drop the injector.

Fitting guidelines

▶ A ◀ Connecting the O-ring and the fuel high pressure hose

1. Apply a small quantity of fresh engine oil to the O-ring, and insert it into the delivery pipe without damaging the O-ring.
2. Check that the high pressure hose can be turned smoothly. If it cannot be turned smoothly there is a possibility that it is biting into the O-ring, so remove the high pressure hose and check for any damage to the O-ring. If the O-ring is undamaged, reinsert it into the delivery pipe and check once more whether the hose can be turned smoothly.
3. Tighten the mounting bolt to the specified torque.

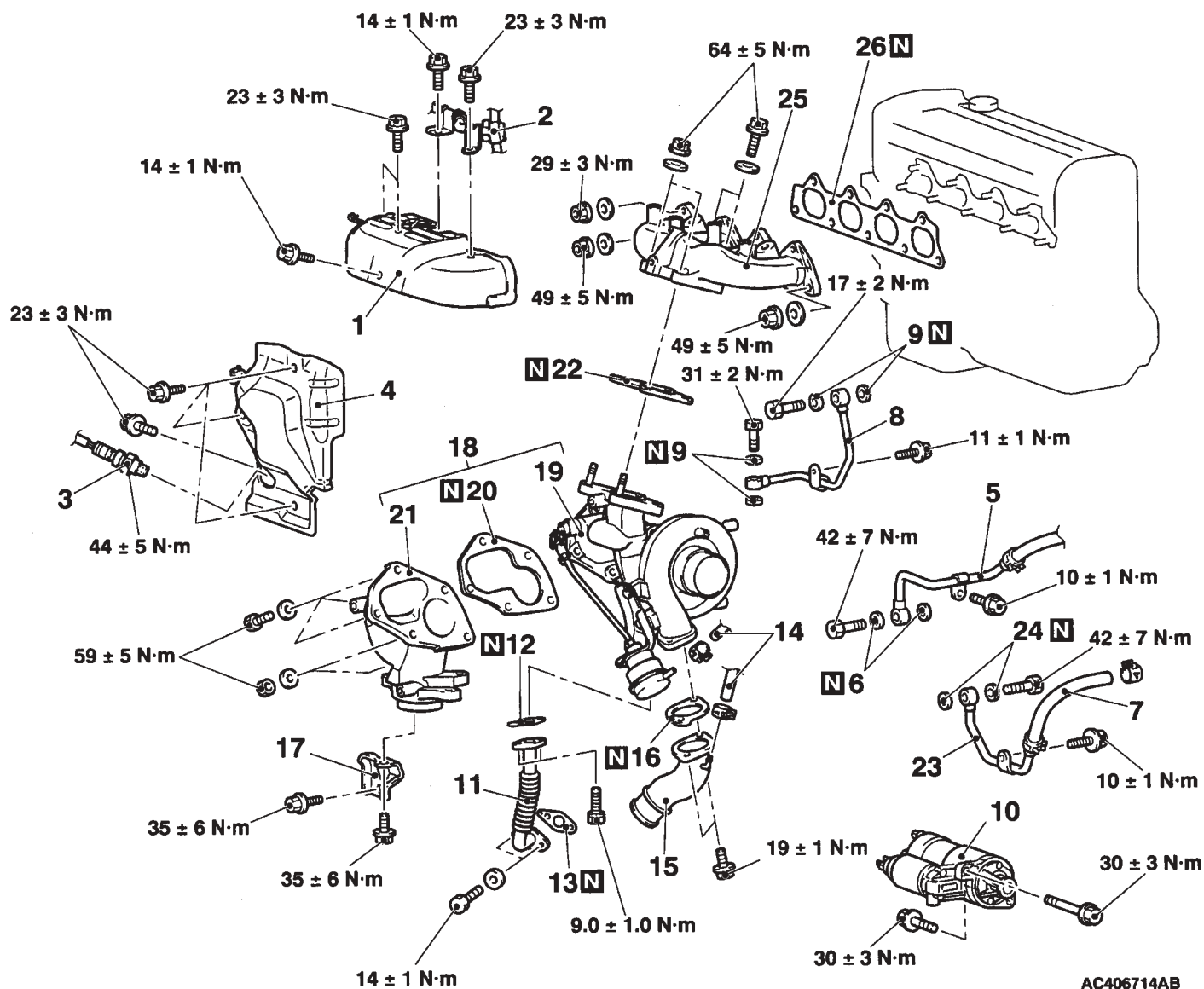
Tightening torque: 5.0 ± 1.0 N·m

Exhaust manifold and turbocharger

Removal and fitting

Jobs to be completed before removal and after fitting

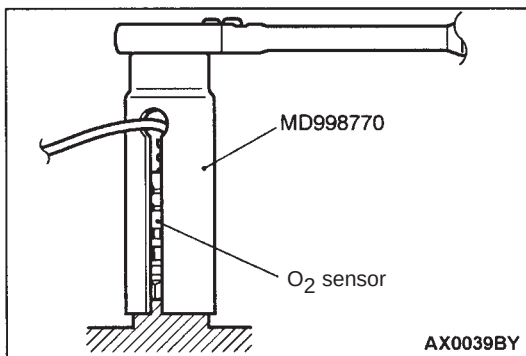
- Removal and refitting of the valence
- Removal and refitting of the radiator
- Removal and refitting of the air intake hose and air hose A
- Removal and refitting of the cross member bar
- Removal and refitting of the front exhaust pipe
- Draining and refilling of the engine oil



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Removal procedure

- | | | |
|---|---|---|
| <p>◀ A ▶</p> <p>◀ B ▶</p> <p>▶ D ▶</p> <p>▶ C ▶</p> | <ol style="list-style-type: none"> 1. Exhaust manifold heat protector 2. Air pipe ASSY connection 3. O₂ sensor 4. Turbocharger heat protector 5. Turbocharger water feed pipe connection 6. Gasket 7. Water hose connection 8. Oil feed pipe 9. Gasket 10. Starter 11. Oil return pipe 12. Oil return pipe gasket (turbocharger side) 13. Oil return pipe gasket (oil pan side) | <ol style="list-style-type: none"> 14. Vacuum hose connection 15. Air outlet fitting ▶ B ▶ 16. Air outlet fitting gasket 17. Exhaust fitting bracket 18. Turbocharger and exhaust fitting ASSY ▶ A ▶ 19. Turbocharger ASSY 20. Exhaust fitting gasket 21. Exhaust fitting 22. Turbocharger gasket 23. Turbocharger water return pipe 24. Gasket 25. Exhaust manifold 26. Exhaust manifold gasket |
|---|---|---|



Removal guidelines

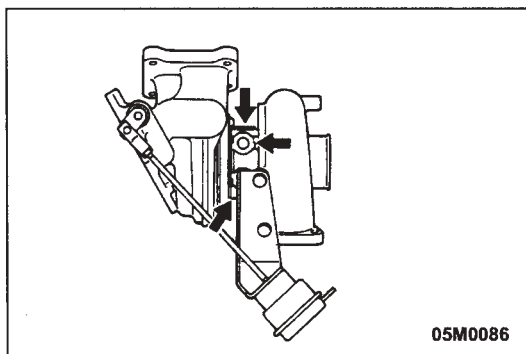
◀ A ▶ Removing the O₂ sensor

After removing the O₂ sensor connector and the clamp, use the special O₂ sensor wrench (MD998770) to remove the O₂ sensor.

◀ B ▶ Removing the oil feed pipe

Caution

After removing the oil feed pipe, ensure that there is no foreign matter in the oil access hole on the turbocharger.



Fitting guidelines

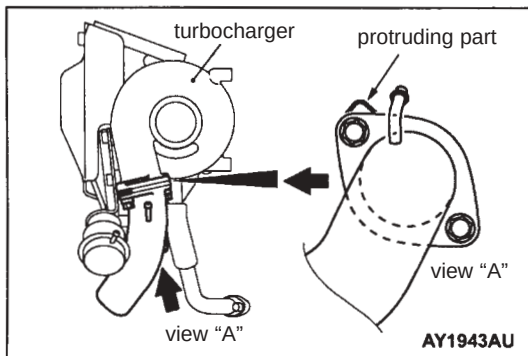
▶ A ▶ Fitting the turbocharger ASSY

1. Clean away any grease clogging the connection between the oil pipe and the water pipe, and any grease clogging the eyebolts and the inside of the pipes.
2. If there is any carbon in the oil access on the turbocharger ASSY, clean it or blow it away.

Caution

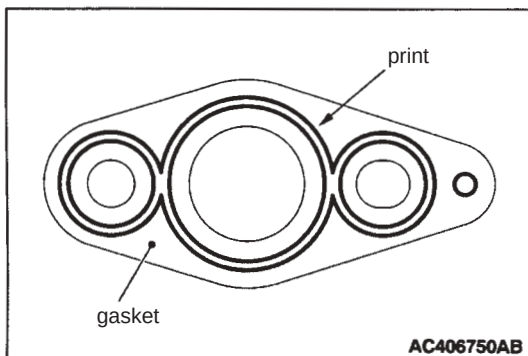
Ensure that no foreign matter gets inside the turbocharger ASSY.

3. Apply some fresh engine oil via the fitting hole for the oil feed pipe in the turbocharger ASSY.



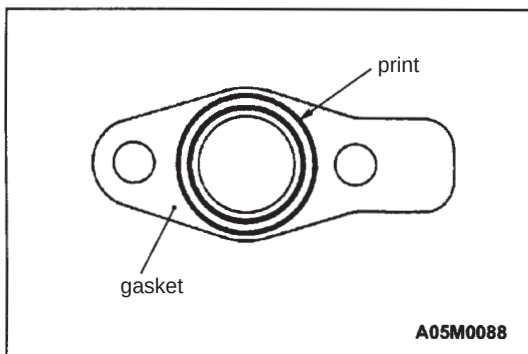
► B ◄ **Fitting the air outlet fitting gasket**

Fit the gasket so that the protruding part is in the position located in the diagram.



► C ◄ **Fitting the oil return pipe gasket (oil pan side)**

Fit so that the printed side of the gasket is on the oil pan side.



► D ◄ **Fitting the oil return pipe gasket (turbocharger side)**

Fit so that the printed side of the gasket is on the turbocharger side.

SECTION 16

ENGINE ELECTRICAL

CONTENTS

Charging system.....	1	Servicing standards.....	4
General	1	On-vehicle servicing.....	4
Alternator	1	Checking, cleaning and replacing spark plugs	4
Ignition system.....	4	Cam position sensor	4
General	4		

Charging system

General

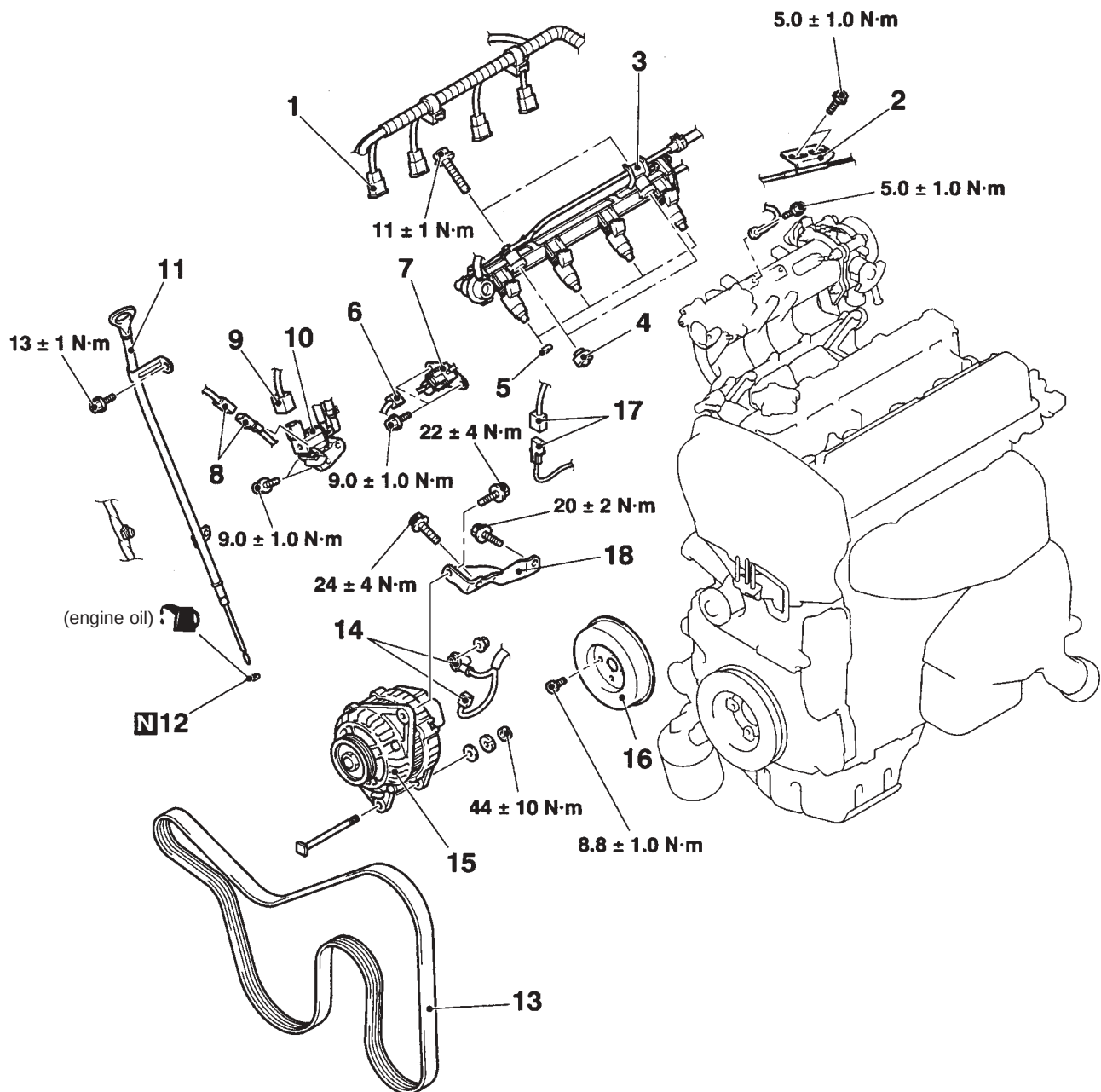
The following alternator servicing guidelines have been prepared for vehicles which use the 4G63-MIVEC-T/C engine. Other servicing guidelines remain unchanged.

Alternator

Removal and fitting

Jobs to be done before removal and after fitting

- Removal and refitting of the valence
- Checking the tension of the drive belt <only after fitting>
- Removal and refitting of the strut tower bar
- Removal and refitting of the front exhaust pipe ASSY
- Adjustment of the accelerator cable <only after fitting>



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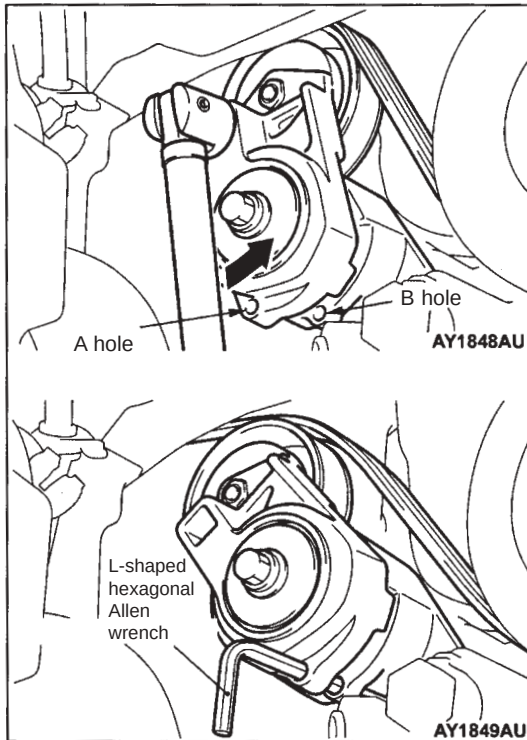
Removal procedure

1. Injector connector
2. Accelerator cable connection
3. Delivery pipe, injector, and fuel pressure regulator ASSY
4. Insulator
5. Insulator
6. Fuel pressure solenoid valve connector
7. Fuel pressure solenoid valve ASSY
8. Knock sensor connector
9. Purge control solenoid valve connector

10. Purge control solenoid valve ASSY
11. Oil level gauge and guide ASSY
12. O-ring
13. Drive belt
14. Alternator connector and terminal
 - Engine mount
15. Alternator
16. Water pump pulley
17. O₂ sensor connector
18. Alternator bracket

Removal guidelines**◀ A ▶ Removing the delivery pipe, the injector, and the fuel pressure regulator ASSY**

Loosen the bolts holding it in place, slightly dislodge all of the components and make space for the alternator to be removed.

**◀ B ▶ Removing the drive belt**

The following procedures are necessary because a serpentine drive system with auto-tensioner has been installed.

1. Insert a 12.7sq spinner handle into the auto-tensioner hole, and turn the auto-tensioner in an anti-clockwise direction until it reaches the stopper.
2. Align the A hole and the B hole, hold them in place by inserting an L-shaped hexagonal Allen Key, and remove the drive belt.

Caution

If planning to re-use the drive belt, ensure that it will be refitted the same way round, by marking the back of the belt with chalk arrows indicating the direction of movement.

◀ C ▶ Removing the alternator

Push the whole engine up using a garage jack, and remove the alternator from above.

Ignition system

General

The following servicing guidelines for spark plugs and the cam position sensor have been prepared for vehicles which use the 4G63-MIVEC-T/C engine. Other servicing guidelines remain unchanged.

Servicing standards

Item	Standard Value	Upper Limit
Spark plug cap mm	0.5~0.6	0.75

On-vehicle servicing

Checking cleaning and replacing spark plugs

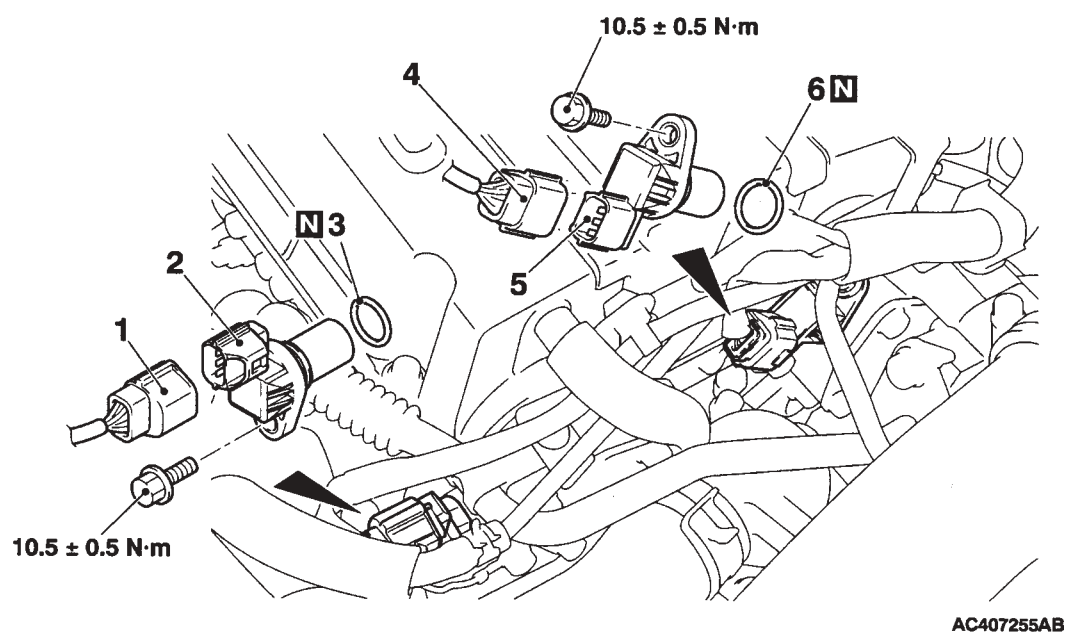
The standard value and the upper limit for plug caps, has been changed in conjunction with the changes made to the spark plugs. Other servicing guidelines remain unchanged.

Standard values and upper limits

Manufacturer	Model	Standard Value mm	Upper Limit mm
NGK	ILFR7H	0.5~0.6	0.75

Cam position sensor

Removal and fitting



Removal procedure <Exhaust side>

1. Cam position sensor connector
2. Cam position sensor
3. O-ring

Removal procedure <Inlet side>

4. Cam position sensor connector
5. Cam position sensor
6. O-ring

SECTION 27B

REAR AXLE

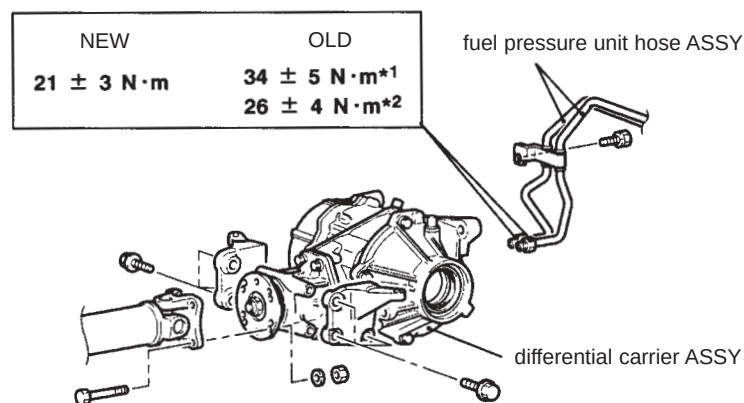
CONTENTS

General.....	1	Differential carrier <vehicles with an AYC system>	1
--------------	---	--	---

General

The tightening torque for the flare nut which joins the fuel pressure unit hose ASSY and the differential carrier ASSY, has been changed. Other servicing guidelines remain unchanged.

Differential carrier <vehicles with an AYC system> Removal and fitting



Note

*1: When the screw is dry.

*2: When the screw is lubricated.

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SECTION 31

WHEELS AND TYRES

CONTENTS

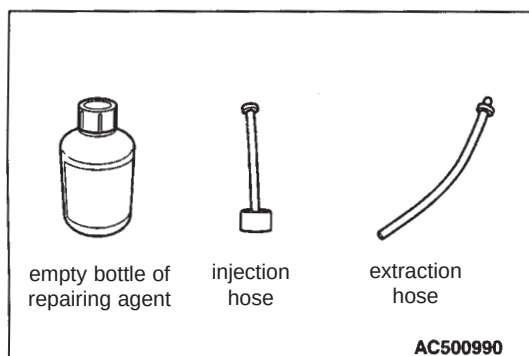
General.....	1	Removal of emergency puncture repairing agent....	1
On-vehicle servicing.....	1	Disposal of emergency puncture repairing agent	2

General

The following servicing guidelines have been prepared now that vehicles are supplied with an emergency puncture repair kit.

On-vehicle servicing**Removal of emergency puncture repairing agent**

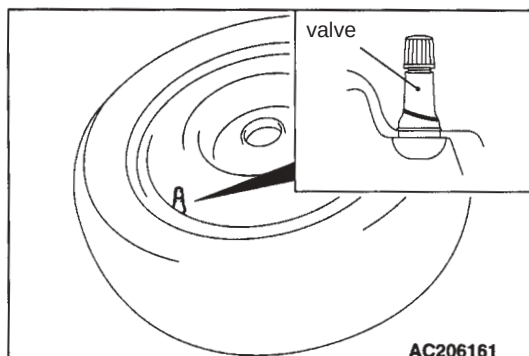
When repairing or replacing a tyre which has been treated using the puncture repair kit, remove the emergency puncture repairing agent (henceforth, repairing agent) from the tyre, in accordance with the guidelines below.

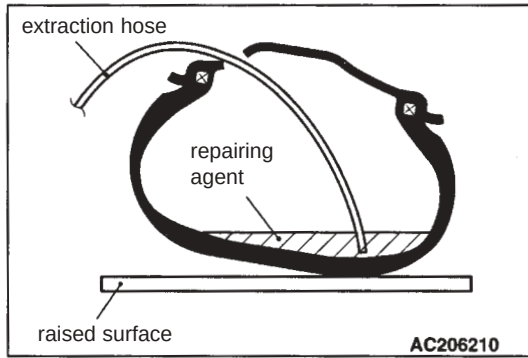
**Note**

When removing the repairing agent, a container (the empty bottle which contained the repairing agent), and the insertion hose and the extraction hose from the emergency puncture repair kit, are needed.

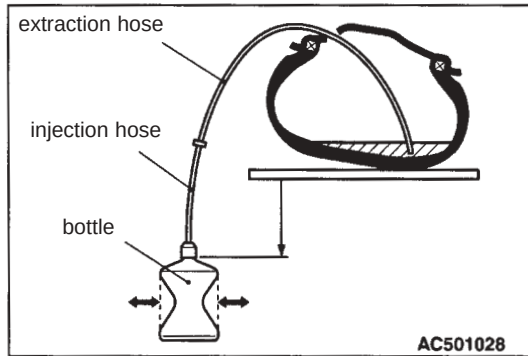
Caution

1. Carry out the operation in a well-ventilated, airy place.
 2. Take appropriate measures in order to prevent repairing agent; getting onto the skin, being inhaled, coming into contact with clothing, or getting into the eyes.
 3. After the job has been completed, wash hands and face thoroughly.
1. Remove the wheel from the vehicle, and remove the air from the tyre.
 2. Cut away the rubber part of the valve using a cutter-knife.
 3. Attach the injection hose to the empty repairing agent bottle, and then attach the extraction hose onto the injection hose.





4. Put the tyre on a raised surface and tilt it to an angle. Insert the extraction hose through the hole made by removing the valve, so that the tip of the hose is submerged in the repairing agent.



5. Hold the bottle so that it is, as far as possible, below the tyre, and suck the repairing agent out of the tyre by squeezing the bottle by hand. Repeat this operation 2 or 3 times, so that as much of the repairing agent as possible is removed.
6. After the repairing agent has been extracted, remove the tyre from the wheel. Remove any repairing agent stuck onto the tyre, and if the place from which air is escaping can be identified, carry out a normal repair procedure. If the place from which air is escaping cannot be identified, replace the tyre.

Disposal of emergency puncture repairing agent

Dispose of the repairing agent extracted from the tyre, and any unused agent which has exceeded its use-by date, in the same way that used oil is discarded.

Note

The use-by date is printed on the bottle of repairing agent (about 3 years from the date of purchase)

Caution

The repairing agent includes propylene glycol which must be handled as industrial waste.

SECTION 33

FRONT SUSPENSION

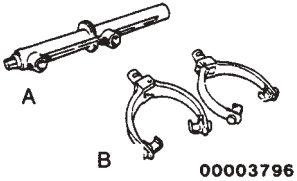
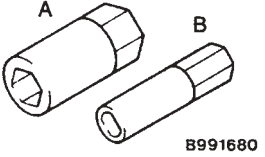
CONTENTS

General.....	1	Strut ASSY	1
Special tools.....	1		

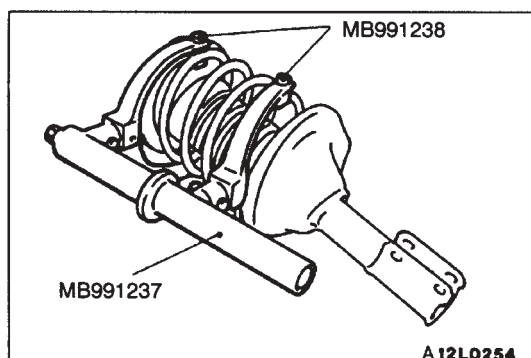
General

The guidelines for the dismantling and assembly of the front suspension have been changed due to changes made to the shape of the Bilstein shock absorbers.

Special tools

Tool	Number	Name	Function
	A: MB991237 B: MB991238	A. Spring compressor body B. Arm set	Dismantling and assembling the strut ASSY
	MB991680 A: MB991681 B: MB991682	Wrench set A. Wrench B. Socket	

Strut ASSY



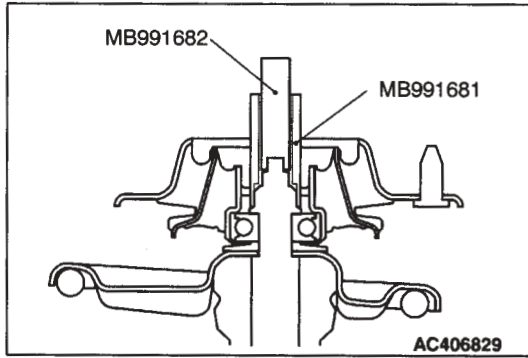
Dismantling guidelines

◀ A ▶ Removal of the self-locking nut

1. Use the following special tools to compress the coil spring.
 - Spring compressor body (MB991237)
 - Arm set (MB991238)

Caution

- (1) In order to completely compress the coil spring, ensure that the special tool is fixed when at its greatest possible extension and that it is fixed evenly to the coil spring.
- (2) Do not use an impact wrench, because there is a danger that the special tool may be damaged.



2. Use the following tools to loosen the self-locking nut.

- Wrench (MB991681)
- Socket (MB991682)

Caution

Do not use an impact wrench when loosening the self-locking nut, because there is a danger that the lock nut on the piston rod inside the strut, may work loose.

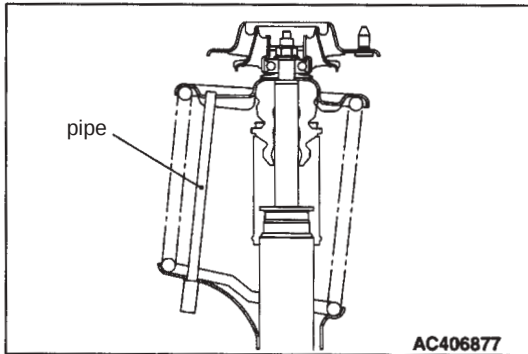
Assembly guidelines

▶ A ◀ **Fitting the self-locking nut**

1. Check that the bearing has completely slotted in.
2. When the coil spring has been compressed using the special tool, provisionally tighten the self-locking nut.

Caution

Do not use an impact wrench because there is a danger that the special tool may be damaged.

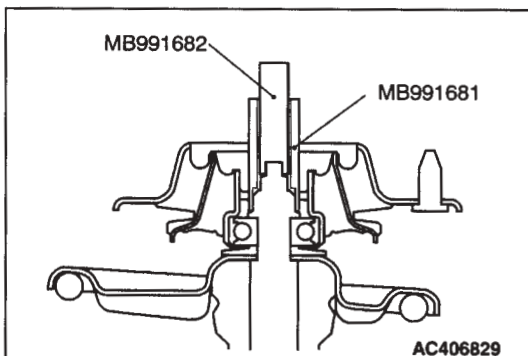


3. Align the holes in the lower spring plate and the upper spring plate of the strut ASSY.

Note

This operation can be easily performed by using a pipe to align the holes.

4. Line up the two ends of the coil spring with the slots in the spring plate, and loosen the special tool.



5. Use the following special tools to tighten the self-locking nut to the specified tightening torque.

- Wrench (MB991681)
- Socket (MB991682)

Tightening torque: 60 ± 10 N·m

Caution

Do not use an impact wrench when loosening the self-locking nut, because there is a danger that the lock nut on the piston rod inside the strut, may work loose.

SECTION 42

BODY

CONTENTS

General.....1	Window glass channel, door-opening weather strip <GT, GSR>.....1
---------------	--

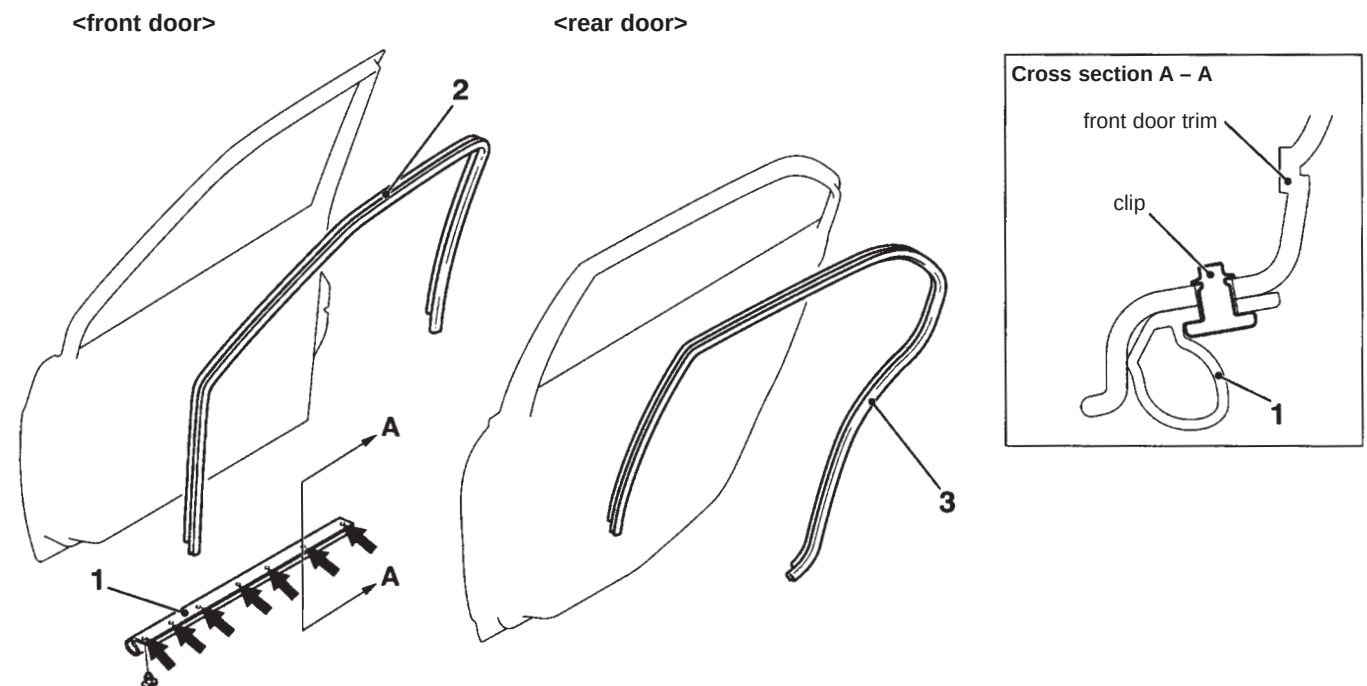
General

Servicing guidelines have been amended in conjunction with the changes listed below. Other servicing guidelines remain unchanged. <GT, GSR>

- Addition of front door opening inner lower weather strip
- Addition of front and rear door opening inner weather strip

Window glass channel, door-opening weather strip <GT, GSR>

Removal and fitting



Note

← : position of clips

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Removal of the front door opening inner lower weather strip

1. Front door opening inner lower weather strip

Procedure for removing the front door opening inner weather strip

- Front scuff plate
- Cowl side trim
- Lower centre pillar trim

2. Front door opening inner weather strip Procedure for removing the rear door opening inner weather strip

- Rear scuff plate
- Lower centre pillar trim
- 3. Rear door opening inner weather strip

SECTION 51

EXTERIOR

CONTENTS

General.....	1	Rear bumper.....	4
Front bumper.....	2	Rear bumper	4
Front bumper.....	2	Markings	6

General

Servicing guidelines have been changed in conjunction with the changes or additions listed below.

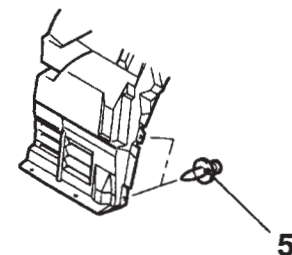
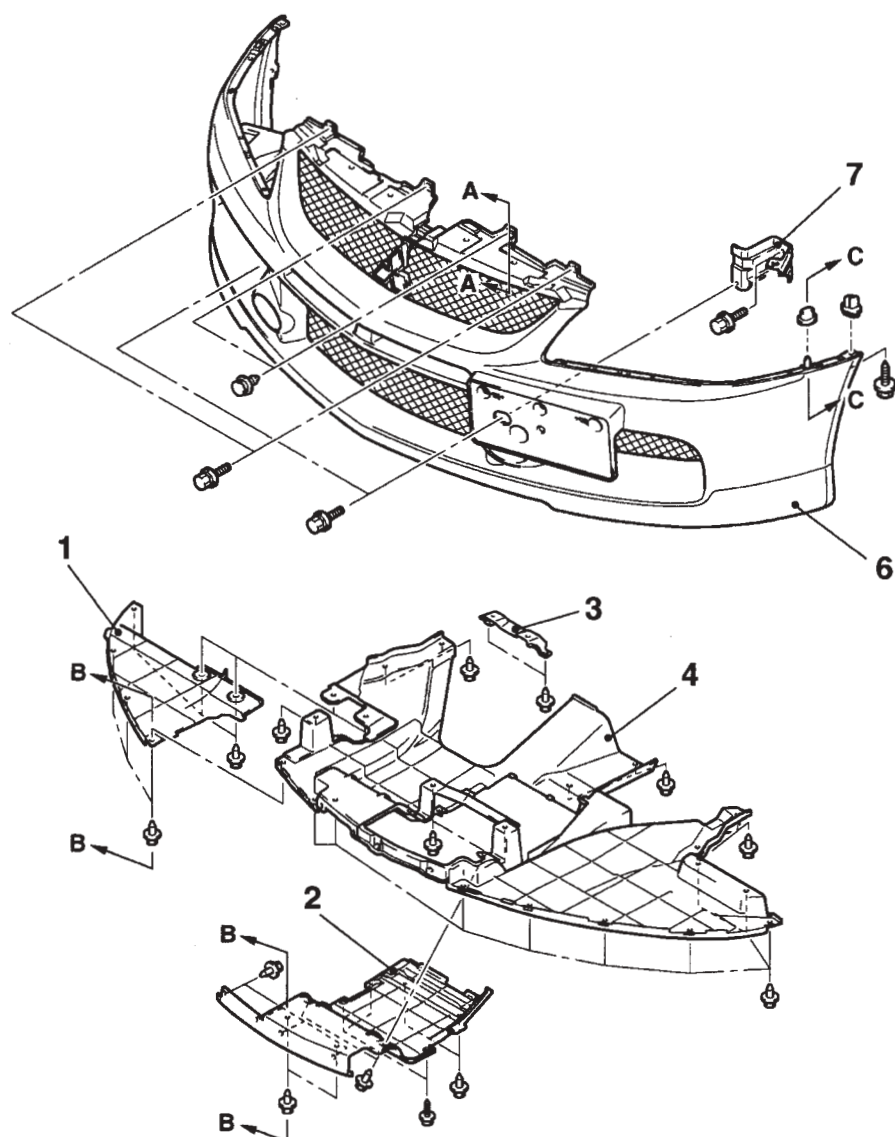
Other servicing guidelines remain unchanged.

- Changes made to the shape and component of the front bumper.
- Changes made to the shape and component of the rear bumper.
- Changes made to the method for affixing the front 3-diamonds badge.
- Changes made to the position for affixing the LANCER badge and the EVOLUTION badge.

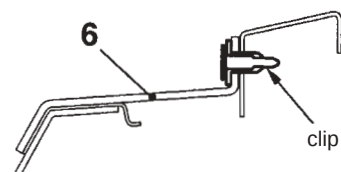
Front bumper

Front bumper

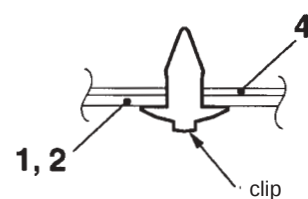
Removal and fitting



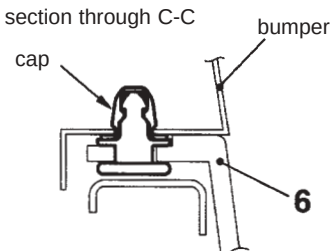
Cross section through A-A



Cross section through B-B



Cross section through C-C



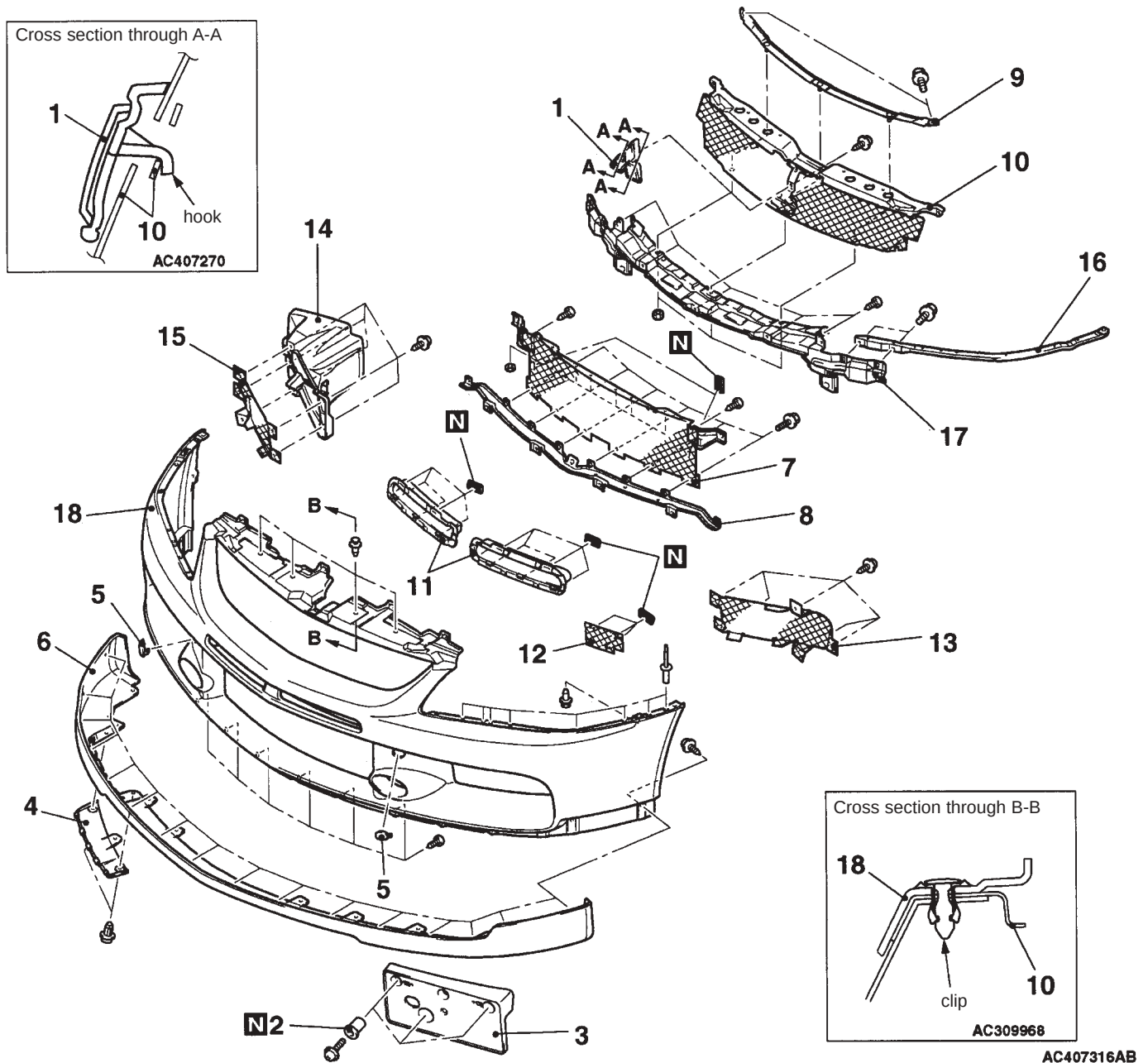
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Removal procedure

1. Side valence
2. Centre valence
3. valence centre bracket
4. Front valence
5. Clip for attaching the splash shield

- Inter-cooler water spray hose connection (Ref Section 15)
- 6. Front bumper ASSY
- 7. Front bumper stay

Dismantling and assembly

**Dismantling procedure**

1. Front 3-diamonds badge
2. Front bumper nut
3. Front number plate garnish
4. Front bumper cover A
5. Front bumper cover B
6. Air dam skirt panel
7. Front bumper centre net
8. Front bumper lower plate
9. Front bumper upper plate
10. Front bumper upper support

11. Air intake cover
12. Front bumper net
13. Bumper side net (LH)
14. Oil cooler duct
15. Bumper side net (RH)
- Inter-cooler water spray hose and nozzle (Ref Section 15)
16. Front bumper side plate
17. Front bumper upper reinforcement
18. Front bumper facing

◀ A ▶ ▶ A ▶

Note:

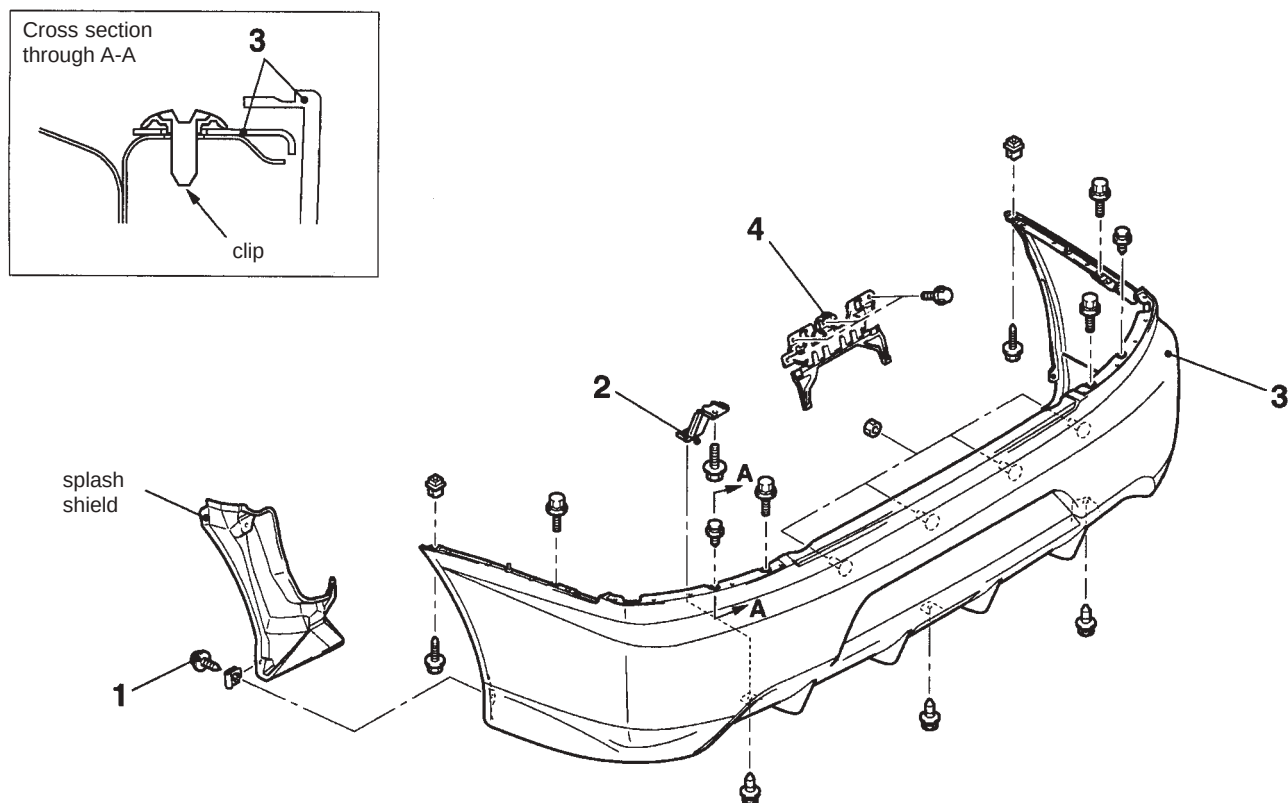
The main points for dismantling and assembly remain unchanged.

Rear bumper

Jobs to be completed before removal and after fitting

- Removal and refitting of the rear combination lamp
- Removal and refitting of the rear end trim
- Removal and refitting of the boot area side trim lid

Rear bumper Removal and fitting



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Removal procedure

1. Screw for attaching the splash shield
2. Rear bumper bracket

3. Rear bumper ASSY
4. Rear number plate bracket

This diagram illustrates the assembly of a boat hull, showing the main hull structure and several components that are attached to it. The components are numbered 1 through 6:

- 1**: A long, narrow component, likely a transom plate or a structural reinforcement, shown being attached to the stern of the hull.
- 2**: A component, possibly a transom plate or a structural reinforcement, shown being attached to the stern of the hull.
- 3**: A long, narrow component, likely a transom plate or a structural reinforcement, shown being attached to the stern of the hull.
- 4**: A component, possibly a transom plate or a structural reinforcement, shown being attached to the stern of the hull.
- 5**: A component, possibly a transom plate or a structural reinforcement, shown being attached to the stern of the hull.
- 6**: A component, possibly a transom plate or a structural reinforcement, shown being attached to the stern of the hull.

The diagram also shows various fasteners (screws, bolts) and a dashed line indicating the location of a component labeled 'N'.

4. Rear bumper facing support, side reinforcement

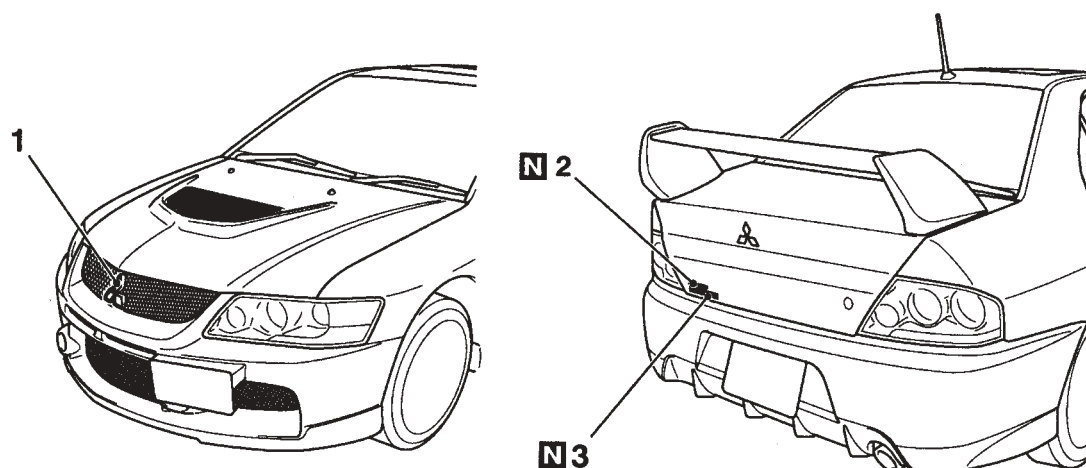
5. Rear bumper valence

6. Rear bumper facing

The main points for dismantling and assembly remain unchanged.

Markings

Removal and affixing



AC407268 AR

1. Front 3-diamonds badge (Ref P.51- 3)

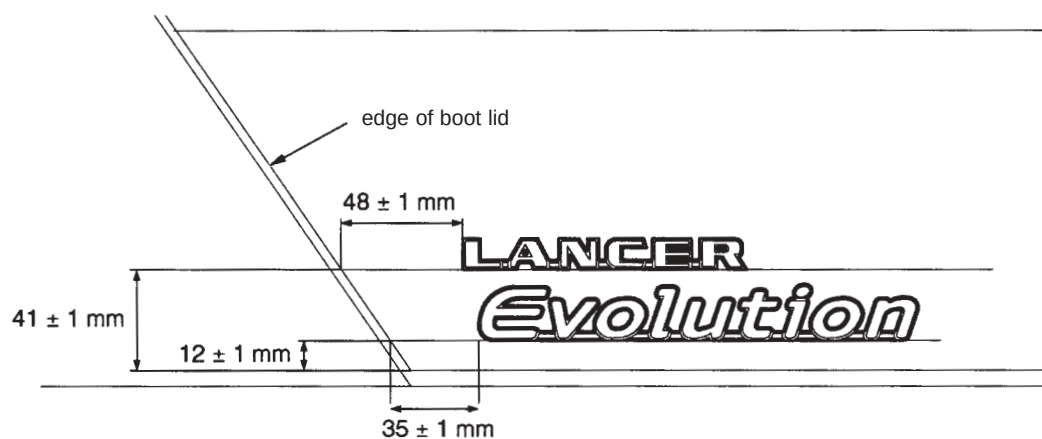
▶ A ◀ 2. LANCER badge
▶ A ◀ 3. EVOLUTION badge

Guidelines for affixing markings

▶ A ◀ Affixing markings

1. Positioning

2. LANCER badge 3. EVOLUTION badge



AC21

2. Guidelines for affixing

- (1) Using white spirit, remove any grease from the place where the badges will be affixed.
- (2) Remove the protective paper from the back of the badges, and affix them in the designated places.

Caution

- 1) Perform this job in an ambient temperature of 20~38°C, and in a dust free location.
- 2) If the job is being performed in an ambient temperature of less than 20°C, warm up the badges, and the area of the body onto which they will be affixed, to a temperature of 20~38°C.
- 3) Ensure that air bubbles are not trapped in the adhesive tape when the badges are affixed.

SECTION 52B

SRS AIRBAG

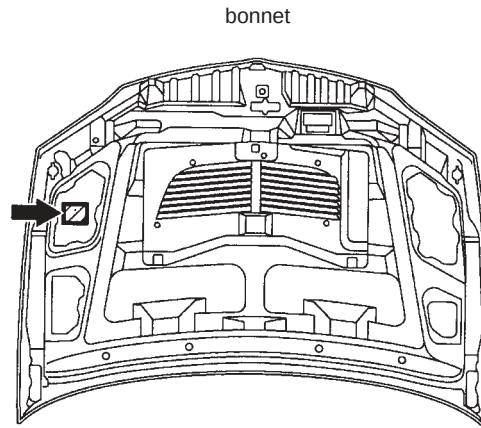
CONTENTS

General.....1

General

A caution label for the airbag has been added on the inside of the bonnet. Other servicing guidelines remain unchanged.

Warning/caution label



SECTION 54A

CHASSIS ELECTRICAL

CONTENTS

Number plate lamp 1

Number plate lamp

Due to changes made to the licence plate lamp, servicing guidelines have been changed to be the same as for the '03 model Lancer.
Other servicing guidelines remain unchanged.

MITSUBISHI

Service Manual Supplement

4G6 DOHC ENGINE



4G63 T/C (2000cc)
Lancer Evolution IX

'05-3
No.1039G71

Service Manual

4G6 DOHC ENGINE

FOREWORD

This manual contains information about the 4G6 DOHC engine. It only covers those points that are different from the service manuals listed below. Therefore, this manual should be used in conjunction with the following manuals.

- 4G6 DOHC engine Service Manual (No. 1039G46)
- 4G6 DOHC engine Service Manual Supplement (No.1039G63)

This manual is based on the engine specifications as of March 2005. Please note that some engine details may not match those given in this manual due to subsequent changes in engine specifications. The units shown in this manual are the standard international SI units.

(However, conventional units are used for some figures taken from existing documents)

If you have any opinions, requests or queries regarding this manual, please write them down on the "Servicing Comment Form" on the last page, and fax them to us.



March 2005
Mitsubishi Motor Corporation

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Exhaust manifold	16
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Oil pump / Sump	21
Pistons / Connecting rods	22
Crank shaft / Cylinder block	25
Turbocharger	27

How to Use this Manual

Range of description

This manual explains the service procedure for the engine after it has been removed from the vehicle. For information on removing the engine from the vehicle, or "on-vehicle" servicing of the engine, please refer to the separate service manual for the relevant vehicle model.

Understanding the description

Service sequence

- (1) A component diagram is provided at the beginning of each section in order to give the reader a clear understanding of where the various parts are installed.
- (2) The numbers in the component diagram indicate the sequence of the service procedure. Tightening torques are shown and non-reusable parts are indicated where appropriate

Removal sequence: The part numbers correspond to the numbers in the component diagram and indicate the removal sequence.

Installation sequence: This is only shown if the parts cannot be installed in the reverse order to the removal sequence.

Disassembly sequence: The numbers of the part names correspond to the symbols in the component diagram and indicate the disassembly sequence.

Assembly sequence: This is only shown if the parts cannot be re-assembled in the reverse order to the disassembly sequence.

Types of service points

"Service point" notes are used to give a detailed description of essential maintenance and service points, standard values, procedures for using special tools, and other important information at relevant points in the service sequence. The different types of "service point" are shown on the right-hand side.

- ◀ A ▶ : Indicates that there is a removal or disassembly service point
- ▶ A ◀ : Indicates that there is an installation or assembly service point
- ◀ *1 ▶ : Indicates that the removal or disassembly service point is described in the '01-14G6 DOHC Engine Service Manual.
- ▶ *1 ◀ : Indicates that the installation or assembly service point is described in the '01-14G6 DOHC Engine Service Manual.
- ◀ *2 ▶ : Indicates that the removal or disassembly service point is described in the '03-14G6 DOHC Engine Service Manual.
- ▶ *2 ◀ : Indicates that the installation or assembly service point is described in the '03-14G6 DOHC Engine Service Manual.

Symbols for lubricants and sealants

Application points for lubricants and sealants are indicated by special symbols (shown right) on the component parts diagram or on the following page.



..... Grease



..... Sealant or liquid gasket (FIPG)



..... Brake fluid



..... Engine oil

Inspection

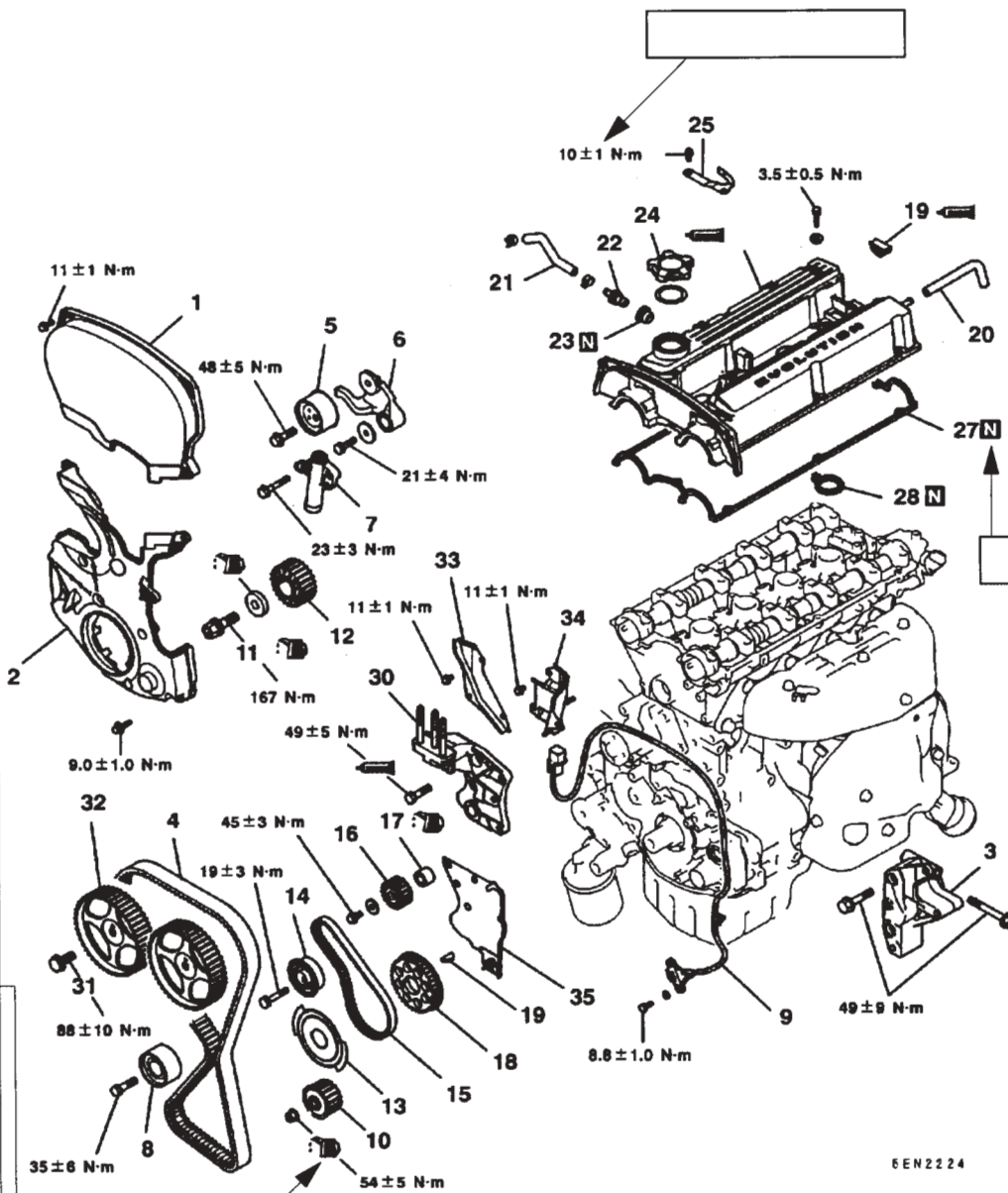
The manual only indicates inspection points where special tools or measuring devices are required. It does not mention general visual checks, part cleaning requirements, and so on, but these must also be carried out as part of the actual service work.

Page number

Engine type

Title

8



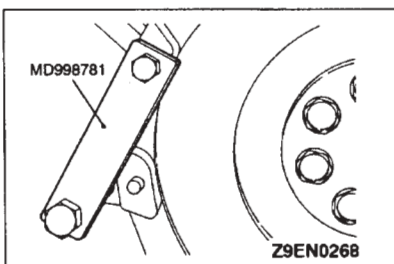
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▶▶

◀*▶▶*
◀*▶▶*
◀*▶▶*

◀

◀A▶



General Information

The 4G63 MIVEC T/C engine fitted in the Lancer Evolution IX incorporates the following changes with respect to the previous 4G63 T/C engine.

- Adoption of variable valve timing control system
- Modification to clearance gap in piston No.2 ring coupling
- Addition of air intake temperature sensor
- Addition of boost sensor

Vehicle Model List

Name	Vehicle model	Engine type	Exhaust capacity cc	Specifications
Lancer Evolution IX	CT9A	4G63-7	1,997	DOHC 16-valve MIVEC – T/C

Specifications

Item	Specification
Bore x stroke	85 x 88
Total displacement cc	1,997
Combustion chamber shape	Pentroof type
No. of cylinders	4
Valve mechanism	Type
	Intake valves
	Exhaust valves
	Lash adjuster
	Rocker arm
Compression ratio	8.8
Fuel injection device	Electronically controlled MPI
Ignition device	Electronically controlled two-coil type
Alternator	AC type (with IC regulator)
Starter motor	Deceleration drive

Servicing Specification Values

Item		Standard value	Limit value
Cylinder head, valves			
Valve spring : free height mm		50.4	49.4
Valve spring : perpendicularity		2° or less	4°
Pistons, connecting rods			
Piston rings : Clearance between ring and ring groove mm	No.1	0.03–0.07	0.1
	No.2	0.02–0.06	0.1
Piston rings : Closed gap mm	No.1	0.20–0.30	0.8
	No.2	0.30–0.45	0.8
	Oil ring	0.10–0.40	1.0

Tightening Torques

Part	Tightening Torque Nm
Alternator, ignition system	
Oil level gauge guide bolt	13 ± 1
Water pump pulley bolt	8.8 ± 1.0
Auto tension bolt (washer)	44 ± 10
Auto tension bolt (flange)	24 ± 4
Alternator bracket bolt (flange)	24 ± 4
Alternator bracket bolt (washer M8 x 22)	22 ± 4
Alternator bracket bolt (washer M8 x 32)	20 ± 2
Alternator nut	44 ± 10
Crankshaft pulley bolt	25 ± 4
Centre cover bolt	3.0 ± 0.5
Ignition coil bolt	10 ± 2
Spark plug	25 ± 5
Timing belt	
Timing belt cover bolt (flange)	11 ± 1
Timing belt cover bolt (washer)	9.0 ± 1.0
Power steering pump bracket bolt	49 ± 9
Connector bracket bolt	11 ± 1
Locker cover bolt	3.5 ± 0.5
Plug cap	32 ± 2
Tensioner pulley bolt	48 ± 5
Tensioner arm bolt	21 ± 4
Auto tensioner bolt	23 ± 3
Idler pulley bolt	35 ± 6
Crank angle sensor bolt	8.8 ± 1.0
Oil pump sprocket nut	54 ± 5
Crankshaft bolt	167
Tensioner B bolt	19 ± 3
Counterbalance shaft sprocket bolt	45 ± 3
Engine support bracket bolt	49 ± 5
V.V.T. sprocket bolt	65 ± 5
Camshaft sprocket bolt	88 ± 10
Fuel system	
Throttle body bolt	19 ± 3
Cover bolt	12 ± 1
Fuel pressure regulator bolt	8.8 ± 2.0
Delivery pipe and injector bolt	11 ± 1
Vacuum hose and pipe bolt	11 ± 1
Solenoid valve assembly bolt	9.0 ± 1.0
Vacuum tank bracket bolt	9.0 ± 1.0
Secondary air system / Intake manifold	
Exhaust manifold heat protector bolt	20 ± 3
Air pipe assembly	

Part	Tightening Torque
Air pipe assembly bolt (eye bolt)	49 ± 5
Air pipe assembly bolt (M6 flange)	11 ± 1
Air pipe assembly bolt (M8 flange)	24 ± 3
Air pipe assembly bolt (M8 washer)	14 ± 1
Air control valve assembly bolt	22 ± 4
Engine hanger bolt	19 ± 3
Intake air temperature sensor	14 ± 1
Boost sensor bolt	5.0 ± 1.0
Intake manifold stay bolt	31 ± 3
Intake manifold bolt (M8)	20 ± 2
Intake manifold bolt nut (M10)	36 ± 6
Exhaust manifold	
Engine hanger bolt	22 ± 3
Turbocharger heat protector bolt	23 ± 3
Oxygen sensor	44 ± 5
Exhaust fitting bracket bolt	35 ± 6
Exhaust filling bolt nut	59 ± 5
Air outlet fitting bolt	19 ± 1
Oil return pipe bolt (flange)	14 ± 1
Oil return pipe bolt (washer)	9.0 ± 1.0
Turbocharger assembly and pipe assembly bolt, nut	64 ± 5
Oil pipe bolt (M10 eye bolt)	17 ± 2
Oil pipe bolt (M12 eye bolt)	31 ± 2
Oil pipe bolt (M12 flange)	11 ± 1
Water pipe bolt (flange)	10 ± 1
Water pipe bolt (eye bolt)	42 ± 7
Exhaust manifold nut (M8)	33 ± 6
Exhaust manifold nut (M10)	55 ± 10
Water pump / Water hose	
Coolant temperature sensor	29 ± 10
Coolant temperature gauge unit	11 ± 1
Water outlet fitting bolt	10 ± 1
Thermostat housing bolt	23 ± 4
Water inlet pipe bolt (M6)	10 ± 1
Water inlet pipe bolt (M8)	13 ± 2
Water pump bolt	14 ± 1
Knock sensor	23 ± 2
Rocker arm / Camshaft	
Cam position sensor bolt	11 ± 1
Cover bolt	10 ± 2
Cam position sensing cylinder bolt	22 ± 4
Cam position sensor support bolt	14 ± 1
Bearing cap bolt	20 ± 1
Oil delivery body bolt	11 ± 1

Part	Tightening Torque
Oil control pump	11 ± 1
Check valve	30 ± 3
Eye bolt	42 ± 2
Oil pipe	11 ± 1
Oil pipe joint	30 ± 3
Oil pump / Sump	
Drain plug	39 ± 5
Sump bolt	9.0 ± 3.0
Oil screen bolt	19 ± 3
Baffle plate bolt	22 ± 4
Oil pressure switch	10 ± 2
Oil cooler bypass valve	54 ± 5
Relief plug	44 ± 5
Oil filter bracket bolt	19 ± 3
Plug cap	23 ± 3
Flange bolt	36 ± 3
Front case bolt	23 ± 3
Oil pump cover bolt	17 ± 2
Oil pump cover screw	10 ± 2
Piston / Connecting rod	
Connecting rod cap nut	20 ± 2 _ +90° ~94°
Crankshaft / Cylinder block	
Flywheel bolt	132 ± 5
Rear plate bolt	11 ± 1
Bell housing cover bolt (flange)	10 ± 2
Bell housing cover bolt (washer)	9.0 ± 1.0
Rear oil seal case bolt	11 ± 1
Beam bearing cap bolt	25 ± 2 _ +90° ~ 100°
Check valve	32 ± 2
Turbocharger	
Waste gate actuator bolt	12 ± 1

Sealants

Part	Specified Sealant
Cam position sensor support *	MZ100191 or equivalent

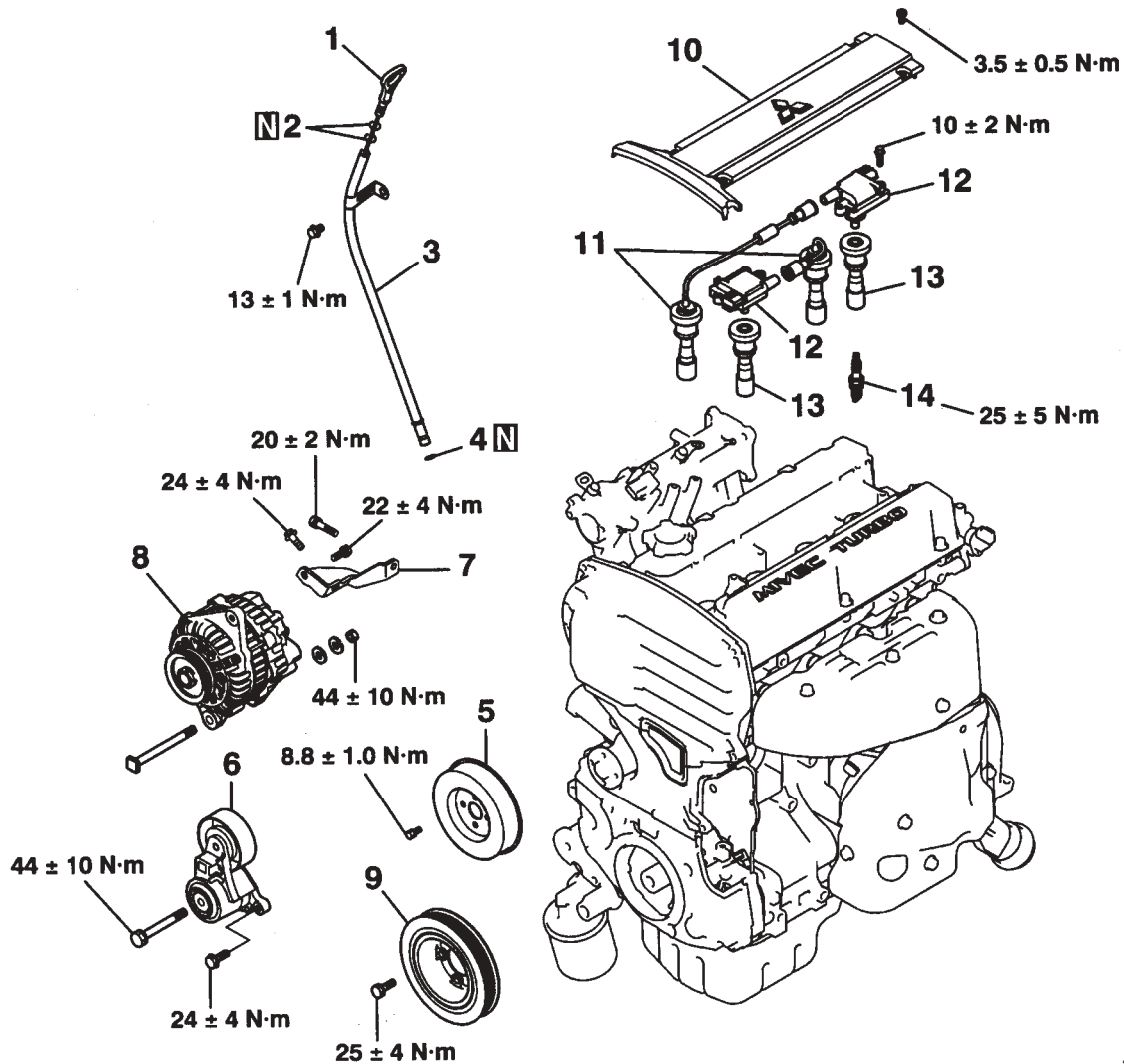
Note : * indicates point where liquid gasket (FIPG) used

Alternator / Ignition System

Removal and Installation

Note :

The ignition coil boot must only be removed from the ignition coil when it is to be replaced.
If removed, always replace with a new part.

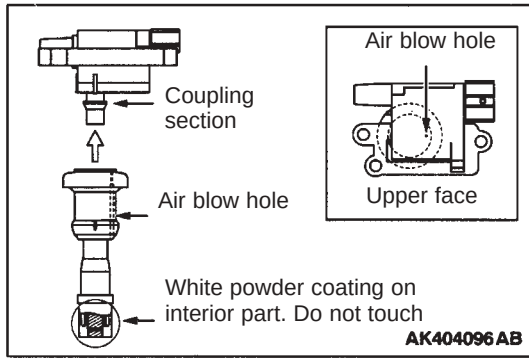


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Removal sequence

1. Oil level gauge
2. O-ring
3. Oil level gauge guide
4. O-ring
5. Water pump pulley
6. Auto tensioner assembly
7. Alternator bracket

8. Alternator
9. Crankshaft pulley
10. Centre cover
11. Spark plug cable
12. Ignition coil
13. Ignition coil boot
14. Spark plug



Removal Service Point

► A ◀ Removal of ignition coil boot

Note :

- If the ignition coil boot is not installed according to the specifications, then this can lead to various problems, such as malfunction of the ignition coil, damage to the ignition coil, leaking of high voltage to external parts, infiltration of water into the hole, etc.
- The spark plug coupling section of the ignition coil boot is coated with a white powder. This coating helps to prevent the boot from welding to the spark plug, and must not be touched or wiped away.

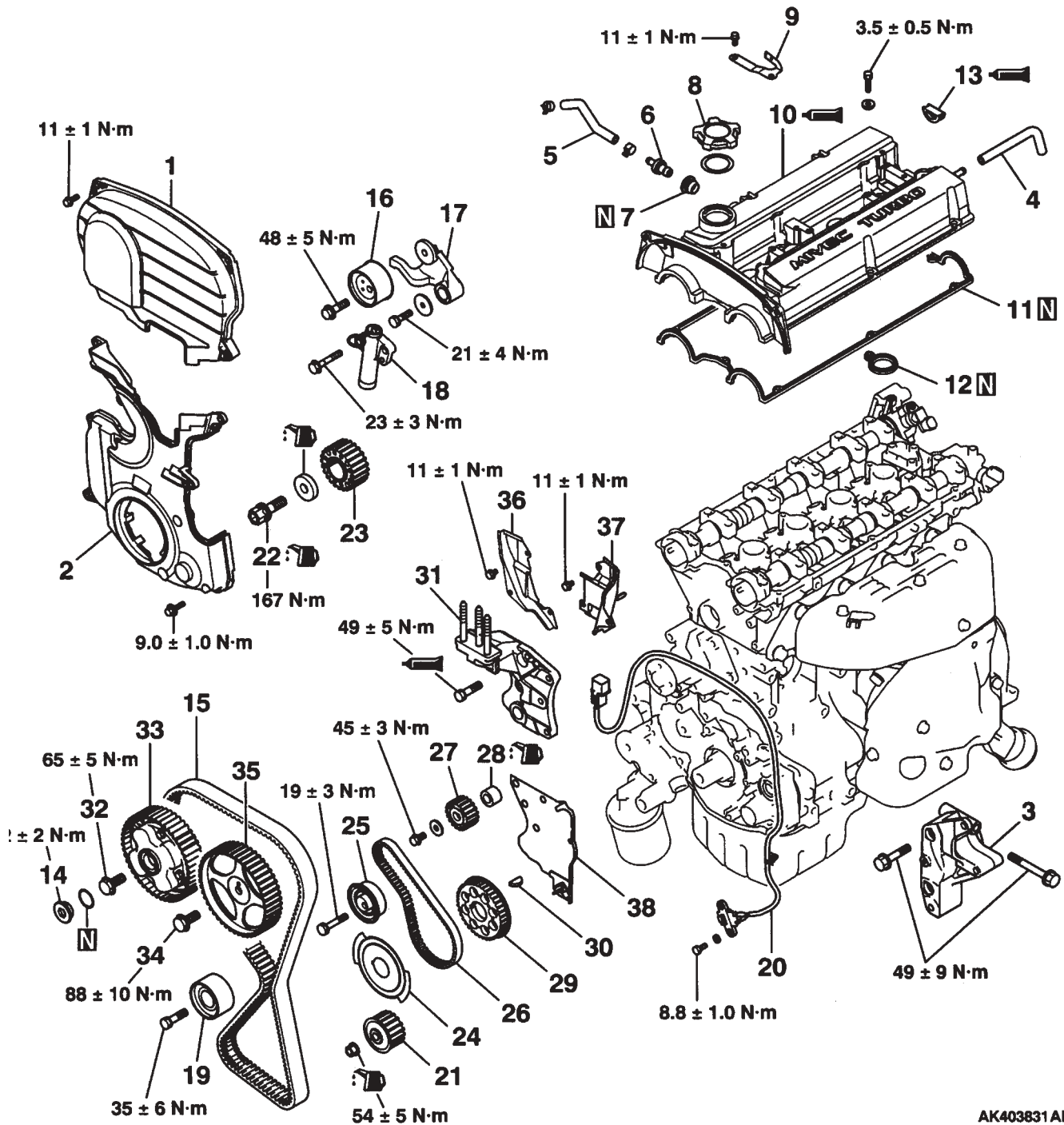
1. Please check that a spring is fitted inside the new ignition coil boot.
2. Press the new ignition coil boot firmly onto the ignition coil, and turn the coupling section 2 or 3 times to seat it correctly in position, ensuring that there are no gaps.
3. After installation, turn the boot until the air blow hole is positioned as shown in the diagram.

Timing Belt

Removal and Installation

Note :

NEVER disassemble the V.V.T. sprocket.

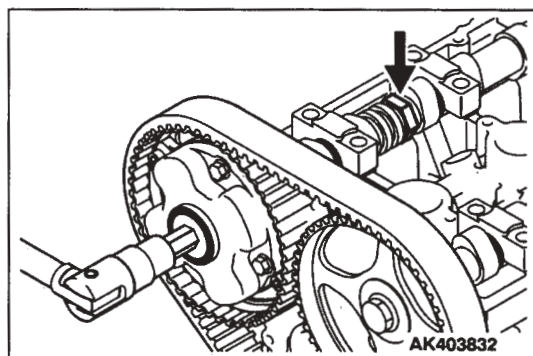


AK403831AB

Removal Sequence

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Power steering pump bracket
4. Breather hose
5. PCV hose
6. PCV valve
7. PCV valve gasket
8. Oil filler cap

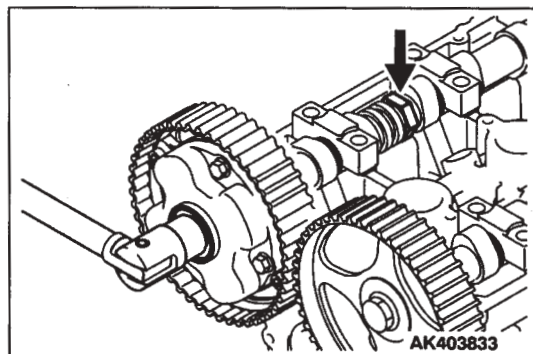
- | | | | |
|---------|------------------------------|---------|---------------------------------------|
| ▶*1 | 9. Connector bracket | ◀*1 ▶*1 | 26. Timing belt B |
| ▶*1 | 10. Rocker cover | ◀*1 ▶*1 | 27. Counterbalance shaft sprocket |
| ▶*1 | 11. Rocker cover gasket A | ▶*1 | 28. Spacer |
| | 12. Rocker cover gasket B | ◀*1 ▶*1 | 29. Crankshaft sprocket B |
| ▶*1 | 13. Semi-circular packing | | 30. Crankshaft key |
| ◀A ▶B | 14. Plug cap | ▶*1 | 31. Engine support bracket |
| ◀*1 ▶*1 | 15. Timing belt | ◀B ▶A | 32. V.V.T. sprocket bolt |
| ▶*1 | 16. Tensioner pulley | ▶A | 33. V.V.T. sprocket |
| | 17. Tensioner arm | ◀*1 ▶*1 | 34. Camshaft sprocket bolt |
| ▶*1 | 18. Auto tensioner | | 35. Camshaft sprocket |
| | 19. Idler pulley | | 36. Timing belt rear right cover |
| | 20. Crank angle sensor | | 37. Timing belt rear left upper cover |
| ◀*1 ▶*1 | 21. Oil pump sprocket | | 38. Timing belt rear left lower cover |
| ◀*1 ▶*1 | 22. Crankshaft bolt | | |
| ◀*1 ▶*1 | 23. Crankshaft sprocket | | |
| ▶*1 | 24. Crankshaft sensing blade | | |
| | 25. Tensioner B | | |



Removal Service Point

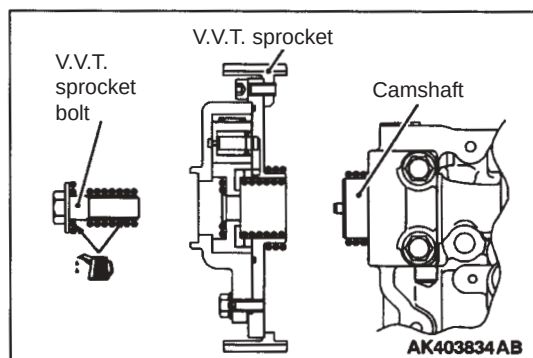
◀A ▶ Removal of plug cap

Hold hexagonal section of camshaft with wrench, and loosen plug cap.



◀B ▶ Removal of V.V.T. sprocket bolt

Hold hexagonal section of camshaft with wrench, and loosen V.V.T. sprocket bolt.

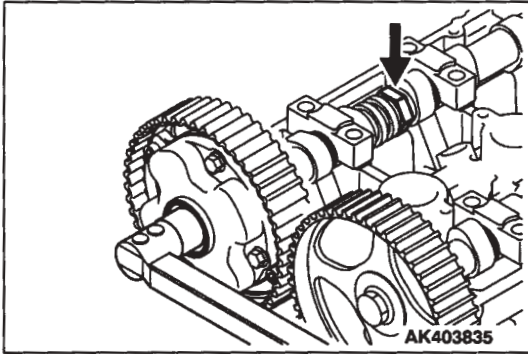


Installation Service Point

◀A ▶ Installation of V.V.T. sprocket bolt / V.V.T. sprocket

1. Apply the minimum suitable coating of engine oil to the following points:
 - Whole circumference of end of camshaft
 - Inserted part of V.V.T. sprocket (full circumference; inner & outer sides)
 - Bolt seating of V.V.T. sprocket bolt
2. Install the V.V.T. sprocket.

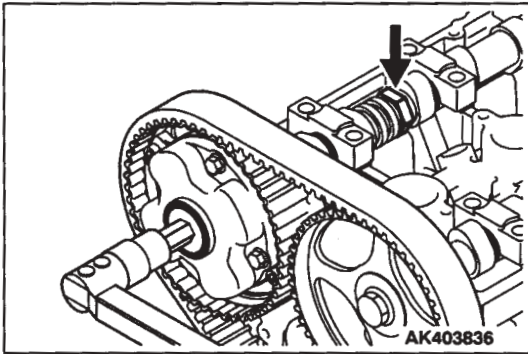
3. Push the V.V.T. sprocket firmly to the end and, holding the hexagonal part of the camshaft with a wrench, check that the V.V.T. sprocket does not rotate.



4. Hold the hexagonal section of the camshaft with a wrench and tighten the V.V.T. sprocket bolt to the specified torque of 65 ± 5 N-m.
5. Hold the hexagonal section of the camshaft with a wrench and check that the V.V.T. sprocket does not rotate.

Note :

This check shows that the V.V.T. sprocket is locked at the maximum delay angle by the interior pin.



► B ◀ Installation of plug cap

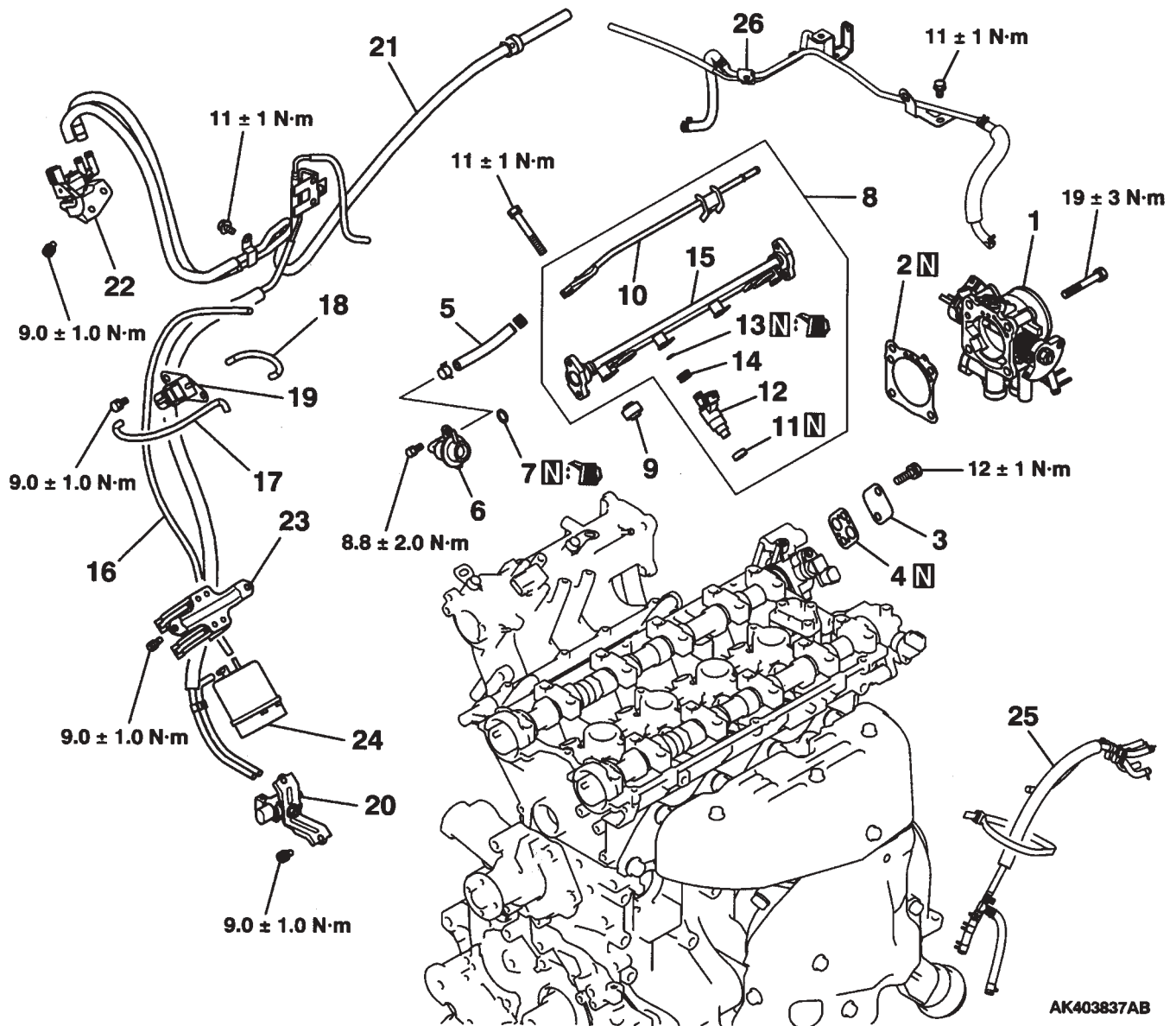
Note :

The washer must not be reused.

1. Install the washer on the plug cap.
2. Hold the hexagonal section of the camshaft with a wrench and tighten the plug cap to the specified torque of 32 ± 2 N-m.

Fuel System

Removal and Installation

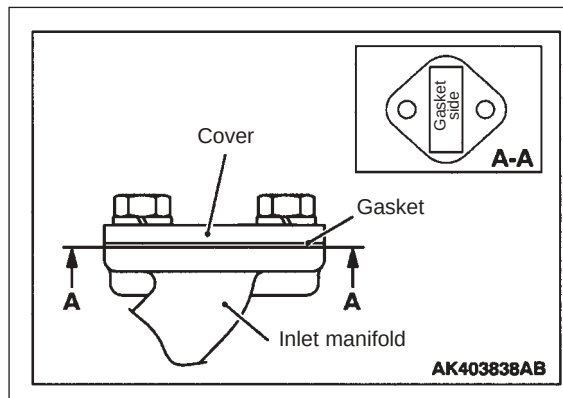


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Removal Sequence

- 1. Throttle body assembly
- *1◄ 2. Throttle body gasket
- A◄ 3. Cover
- 4. Gasket
- 5. Fuel hose
- *1◄ 6. Fuel pressure regulator
- 7. O ring
- 8. Delivery pipe and injector
- 9. Insulator
- 10. Fuel return pipe
- 11. Insulator
- *1◄ 12. Injector
- 13. O ring

- 14. Grommet
- 15. Delivery pipe
- 16. Vacuum hose
- 17. Vacuum hose
- 18. Vacuum hose
- 19. Solenoid valve assembly
- 20. Solenoid valve assembly
- 21. Vacuum hose and pipe
- 22. Solenoid valve assembly
- 23. Vacuum tank bracket
- 24. Vacuum tank
- 25. Vacuum hose assembly
- 26. Vacuum hose and pipe



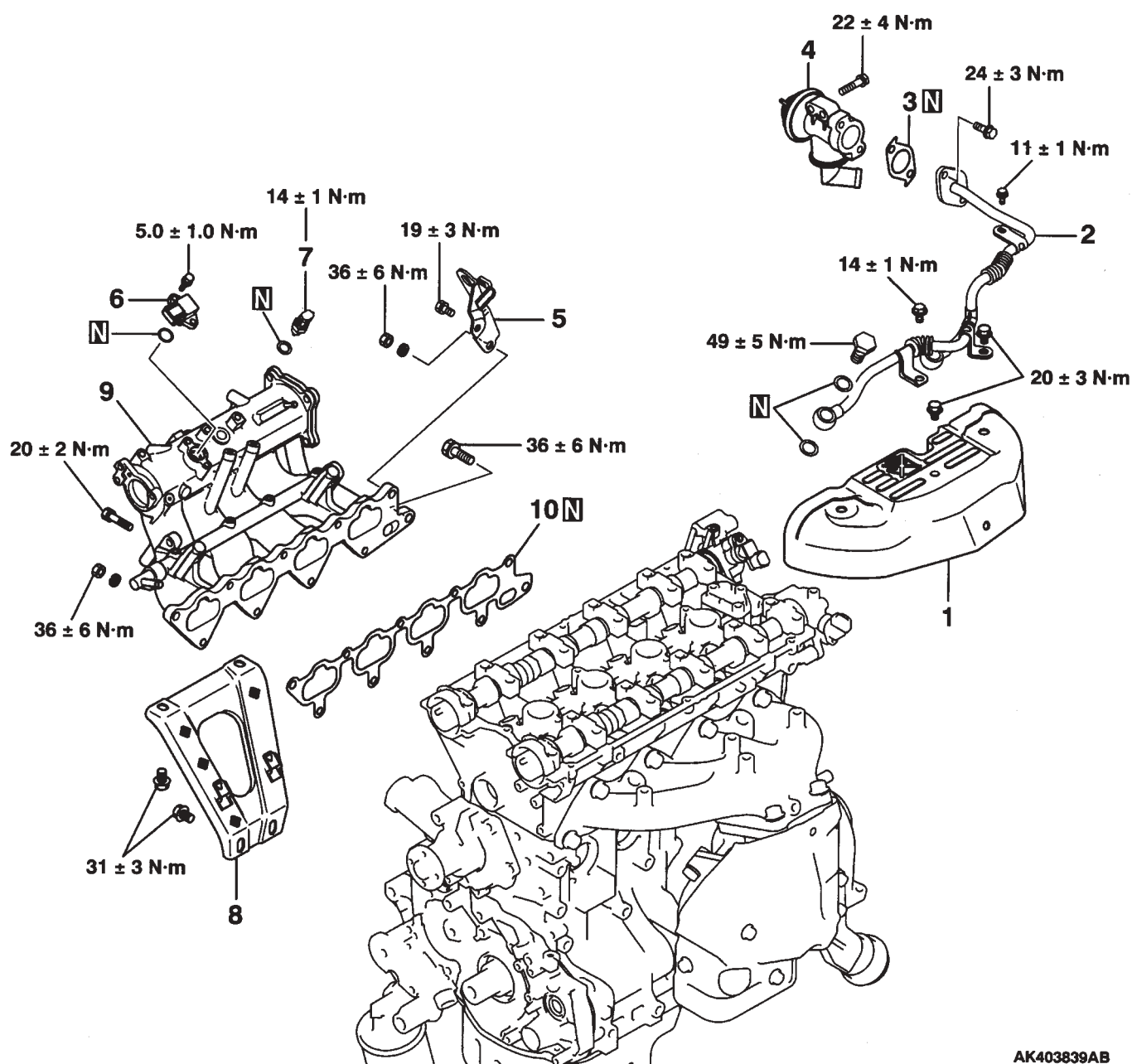
Installation Service Point

► A ◀ Installation of cover

The side of the cover marked "gasket side" should be assembled facing the inlet manifold.

Secondary Air System / Inlet Manifold

Removal and Installation



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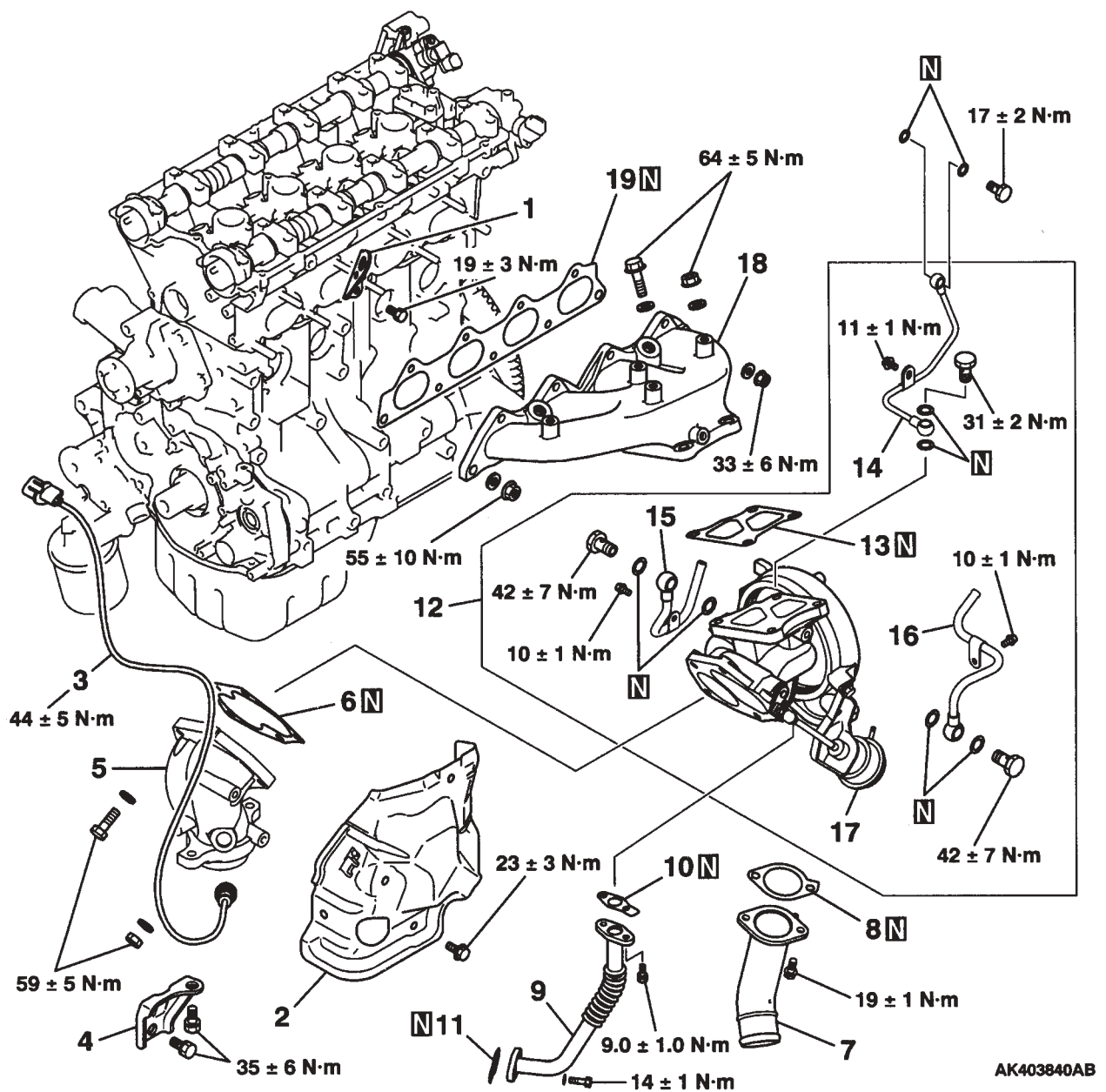
Removal Sequence

1. Exhaust manifold heat protector
- ▶*1◀ 2. Air pipe assembly
3. Air control valve gasket
4. Air control valve assembly
5. Engine hanger

- ▶*1◀ 6. Intake air temperature sensor
- ▶*1◀ 7. Boost sensor
- ▶*1◀ 8. Inlet manifold stay
- 9. Inlet manifold
- 10. Inlet manifold gasket

Exhaust Manifold

Removal and Installation



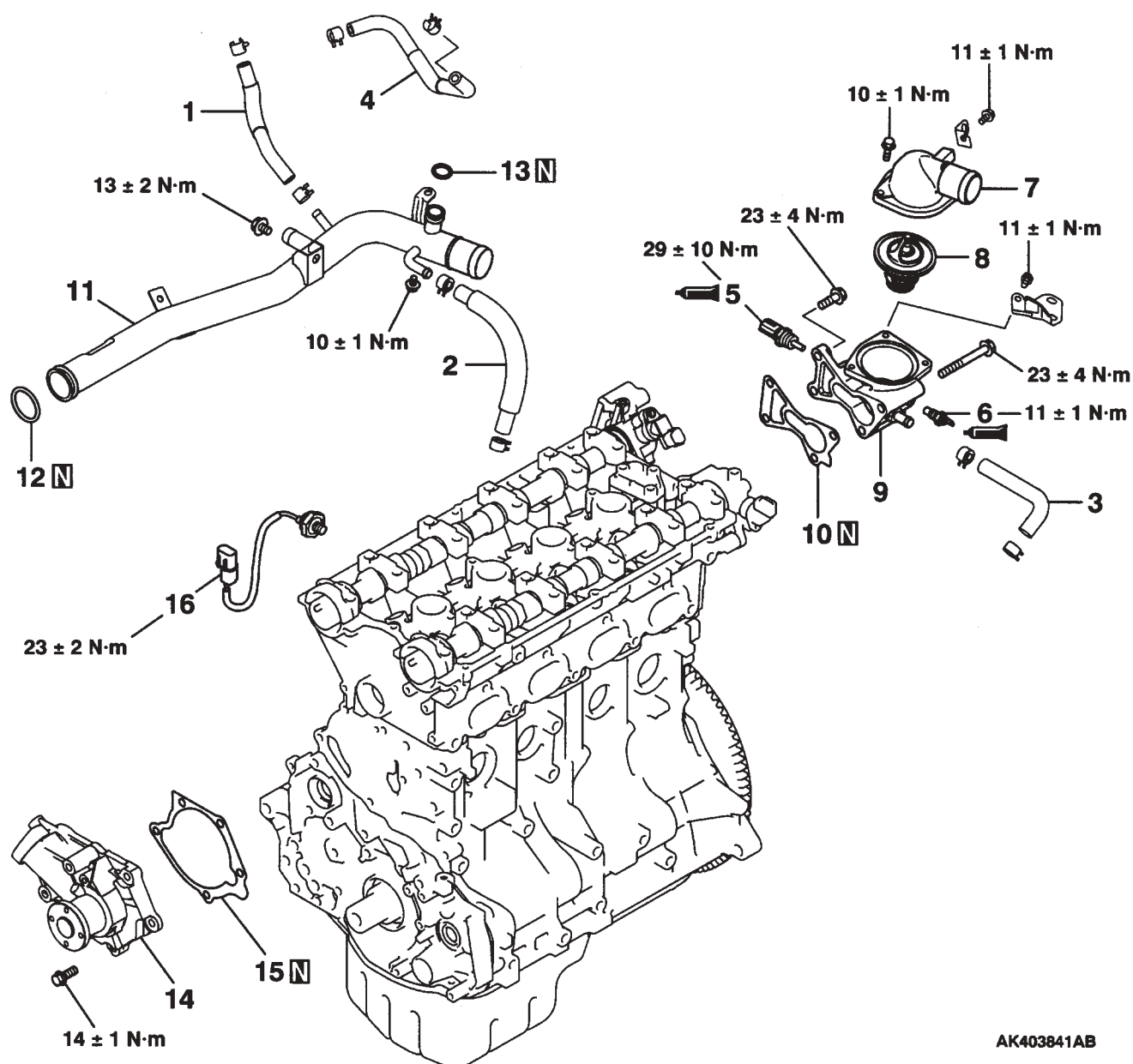
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Removal Sequence

- | | |
|-----------------------------------|---|
| 1. Engine hanger | 10. Oil return pipe gasket |
| 2. Turbocharger heat protector | ▶*1◀ 11. Oil return pipe gasket |
| 3. Oxygen sensor | 12. Turbocharger assembly & pipe assembly |
| 4. Exhaust fitting bracket | 13. Turbocharger gasket |
| 5. Exhaust fitting | 14. Oil pump |
| 6. Exhaust fitting gasket | 15. Water pipe B |
| 7. Air outlet fitting | 16. Water pipe A |
| ▶*1◀ 8. Air outlet fitting gasket | 17. Turbocharger assembly |
| 9. Oil return pipe | ▶*1◀ 18. Exhaust manifold |
| | 19. Exhaust manifold gasket |

Water Pump / Water Hose

Removal and Installation



AK403841AB

Removal Sequence

1. Water hose
2. Water hose
3. Water hose
4. Water hose
- ▶*1◀ 5. Coolant temperature sensor
- ▶*1◀ 6. Coolant temperature gauge unit
7. Water outlet fitting
8. Thermostat

9. Thermostat housing
10. Gasket
- ▶*1◀ 11. Water inlet pipe
- ▶*1◀ 12. O-ring
13. O-ring
14. Water pump
15. Water pump gasket
16. Knock sensor

Installation Service Point

► A ◀ Installation of OCV filter

Note :

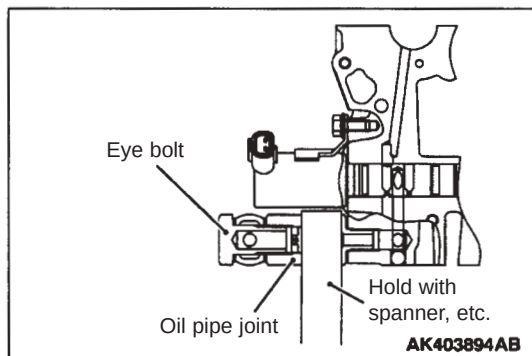
Before fitting the filter, check that it is clean and is not damaged or deformed in any way.

► B ◀ Installation of eye bolt

Note :

The oil pump may be damaged if the oil pipe joint turns with the eye bolt when it is fitted.

Hold the oil pipe joint in place with a spanner, etc., and then tighten the eye bolt to the specified torque 42 ± 2 N-m.

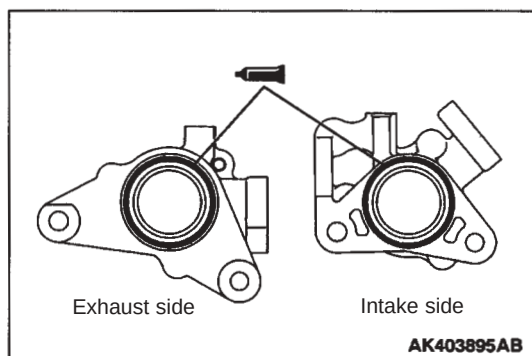


► C ◀ Installation of cam position sensor support

1. Wipe away all traces of the old liquid gasket left on the cam position sensor support and the cylinder head.
2. Apply a 3 mm-thick coat of the liquid gasket to the parts of the cam position sensor support indicated on the diagram.

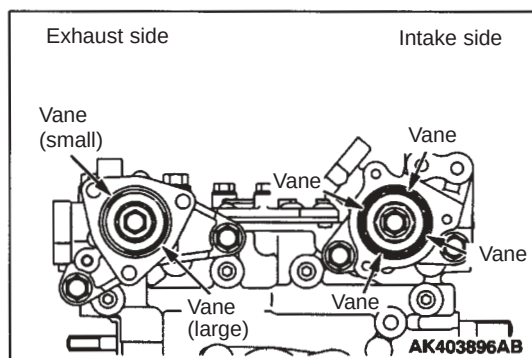
Liquid Gasket

Product name : MZ100191 or equivalent



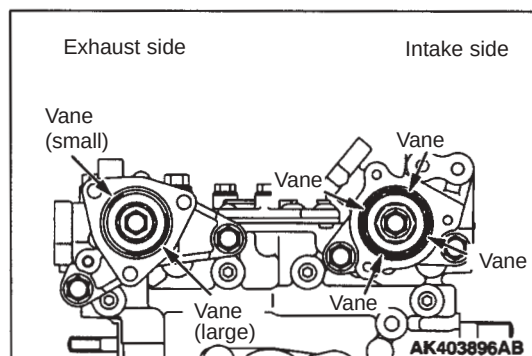
► D ◀ Installation of cam position sensing cylinder

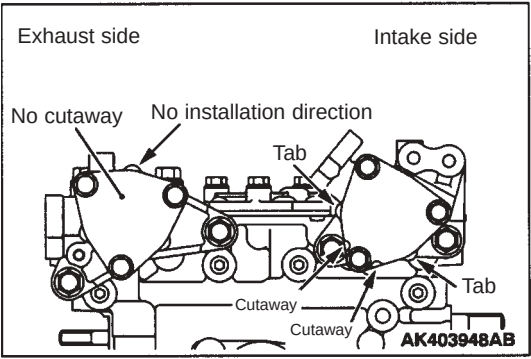
1. Set the camshaft to the top dead centre for No.1.
2. Install the various vanes of the cam position sensing cylinder at the positions indicated on the diagram.



► E ◀ Installation of cover / gasket

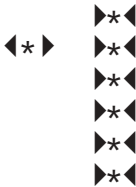
1. Before installing the cover and gasket, put the camshaft to the No.1 top dead centre position, and check that the vanes of the respective sensing cylinders are located in the positions shown in the diagram.





2. Ensure that the cutaways in the intake side cover and the tabs on the gasket are aligned with the positions shown in the diagram, and tighten at the specified torque of 14 ± 1 N-m. The exhaust side cover and gasket do not have a specified installation direction.

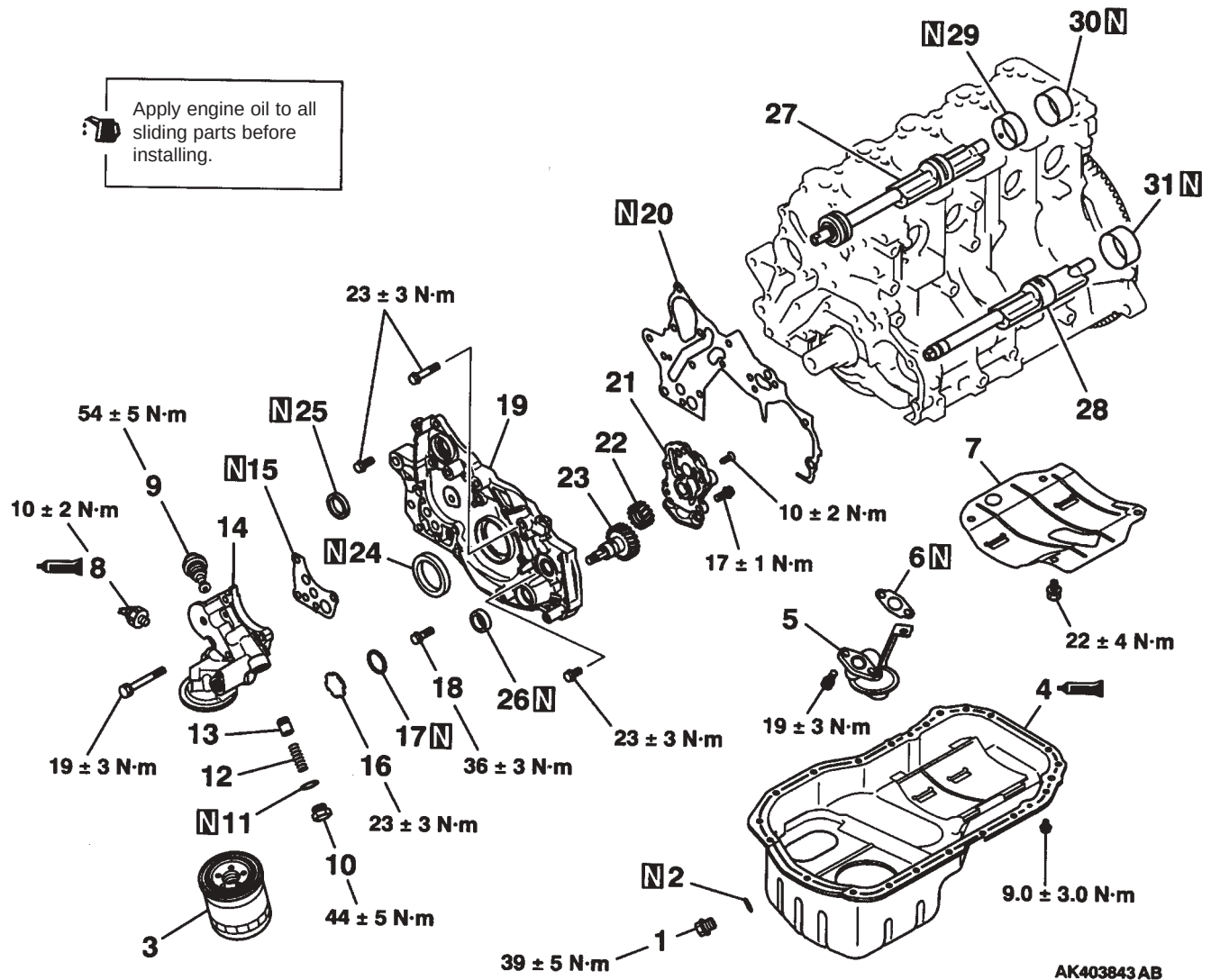
Comment :
The cover and gasket do not have distinct front and rear sides.



Oil Pump / Oil Pan

Removal and Installation

Apply engine oil to all sliding parts before installing.



Removal Sequence

1. Drain plug
- ▶*1◀ 2. Drain plug gasket
- ▶*1◀ 3. Oil filter
- ◀*1▶▶*1◀ 4. Oil pan
5. Oil screen
6. Oil screen gasket
7. Baffle plate
- ▶*1◀ 8. Oil pressure switch
9. Oil cooler bypass valve
10. Relief plug
11. Gasket
12. Relief spring
13. Relief plunger
14. Oil filter bracket
15. Oil filter bracket gasket
- ◀*1▶▶*1◀ 16. Plug cap
17. O ring

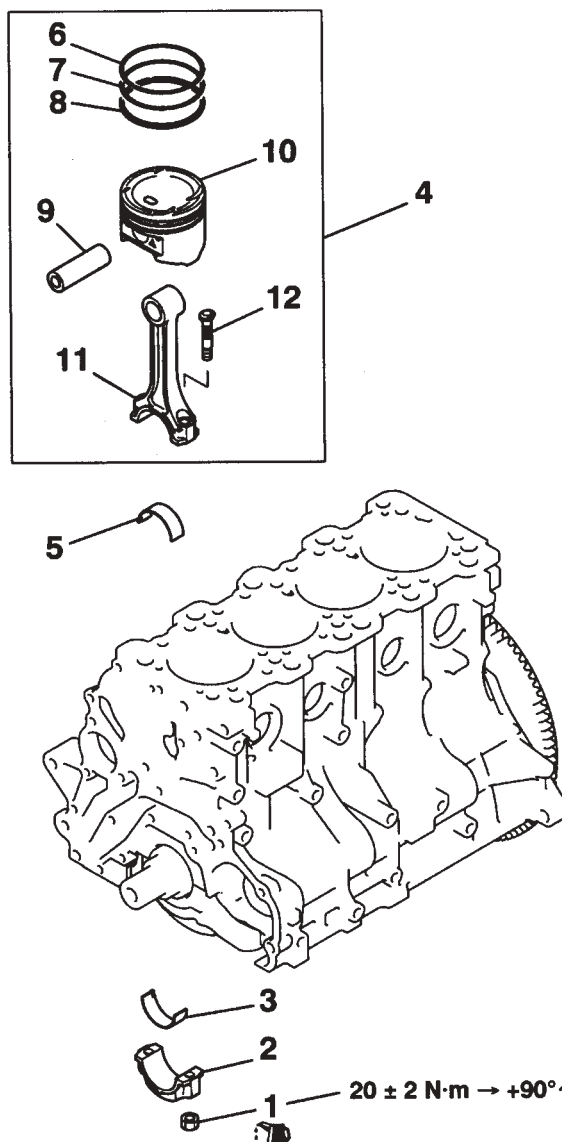
- ◀*1▶▶*1◀ 18. Flange bolt
- ▶*1◀ 19. Oil pump case
- ▶*1◀ 20. Oil pump case gasket
21. Oil pump cover
- ▶*1◀ 22. Oil pump driven gear
- ▶*1◀ 23. Oil pump drive gear
- ▶*1◀ 24. Crankshaft front oil seal
- ▶*1◀ 25. Counterbalance shaft oil seal
- ▶*1◀ 26. Oil pump oil seal
27. Counterbalance shaft, right
28. Counterbalance shaft, left
- ◀*1▶▶*1◀ 29. Counterbalance shaft front bearing
- ◀*1▶▶*1◀ 30. Counterbalance shaft rear bearing, right
- ◀*1▶▶*1◀ 31. Counterbalance shaft rear bearing, left

Piston / Connecting Rod

Removal and Installation



Apply engine oil to all sliding parts before installing.



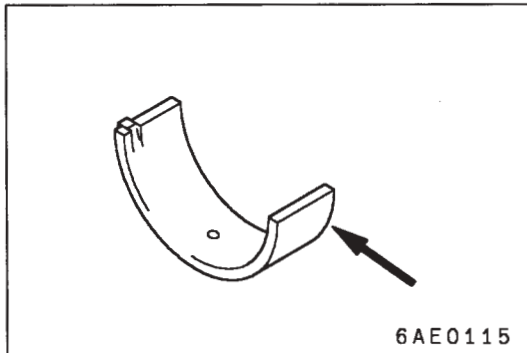
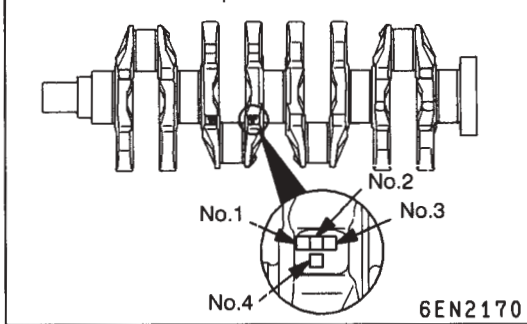
AK403844AB

Removal Sequence

- ▶*1◀ 1. Connecting rod cap nut
- ◀*1▶▶*1◀ 2. Connecting rod cap
- ▶A◀ 3. Connecting rod bearing
- ▶*1◀ 4. Piston connecting rod
- ▶A◀ 5. Connecting rod bearing
- ▶*1◀ 6. Piston ring No. 1

- ▶*1◀ 7. Piston ring No. 2
- ▶*2◀ 8. Oil ring
- ◀*1▶▶*1◀ 9. Piston pin
- 10. Piston
- 11. Connecting rod
- 12. Bolt

Position of crankshaft pin diameter identification marks



Installation Service Point

▶ A ◀ Installation of bearings on connecting rod

1. When replacing a bearing, connecting rod or crankshaft, choose a bearing of the correct size which corresponds to the external diameter of the crankshaft pin, in accordance with the identification marks on the crankshaft pin and the connecting rod bearing given in the table below.
2. The crankshaft identifier is engraved in the position shown in the diagram.
3. The bearing identifier is engraved or printed at the position shown in the diagram.

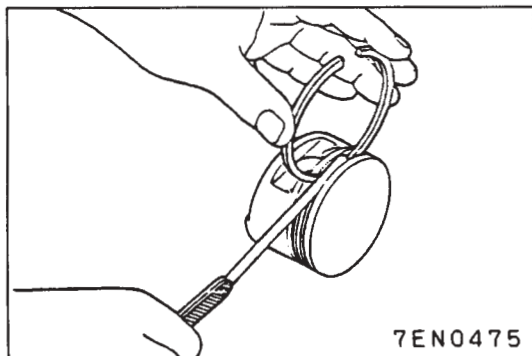
Crankshaft pin		Connecting rod bearing
Identification mark	External diameter of pin (mm)	Identification mark
I	44.995 – 45.005	0
II	44.985 – 44.995	1
III	44.980 – 44.985	2

(Selecting a bearing : Example)

If the crankshaft identification mark is I, then choose a bearing with the identification mark 0.

If it is difficult to make out the crankshaft identifier, measure the external diameter of the pin and then choose the bearing that corresponds to that diameter.

4. The selected bearing should be installed in the larger end of the connecting rod and the cap.



Inspection

Piston rings

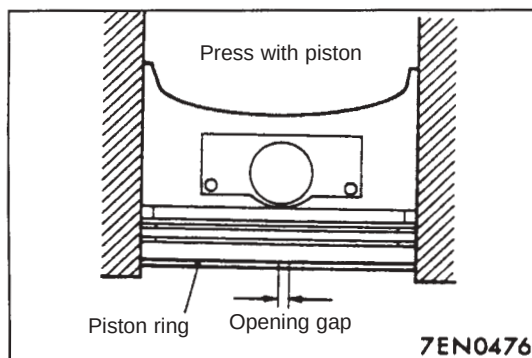
1. Check the clearance between the piston rings and the piston grooves. If it exceeds the clearance limit value, replace the piston ring, or both the piston ring and the piston.

Standard values :

No. 1 0.03 – 0.07 mm

No. 2 0.02 – 0.06 mm

Limit value : 0.1 mm



2. Insert the piston ring and the side rail of the oil ring into the cylinder bore, and press in using the top surface of the piston. After reaching a right-angle position, measure the opening gaps in the rings using a thickness gauge.

Remark :

Press the openings of the piston ring and the oil ring side rail with the piston in the position shown in the diagram, and measure the opening gaps in this position.

Standard value

No. 1 0.20 – 0.30 mm

No. 2 0.35 – 0.45 mm

Oil ring 0.10 – 0.40 mm

Standard value

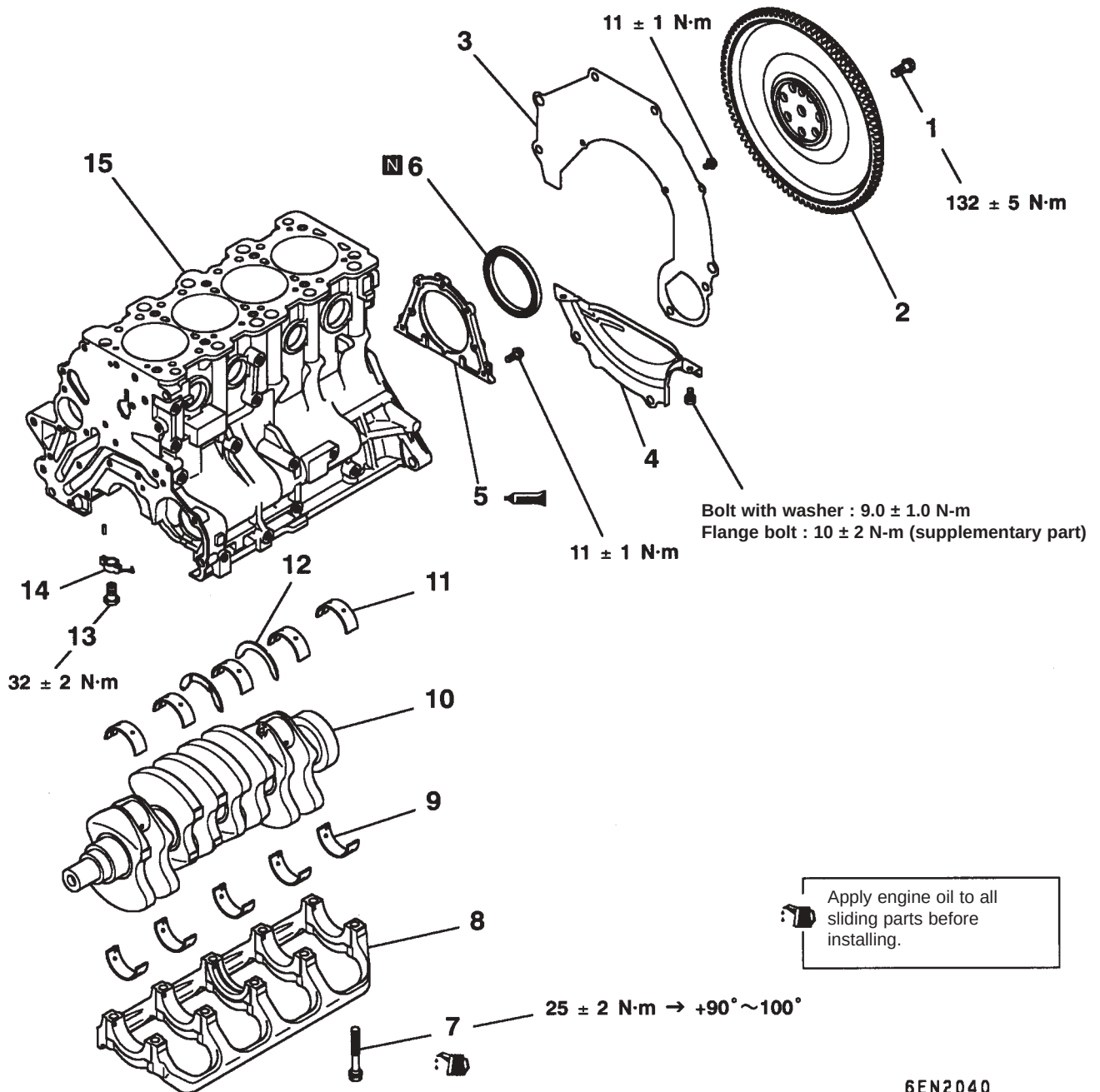
No. 1 0.8 mm

No. 2 0.8 mm

Oil ring 1.0 mm

Crankshaft / Cylinder Block

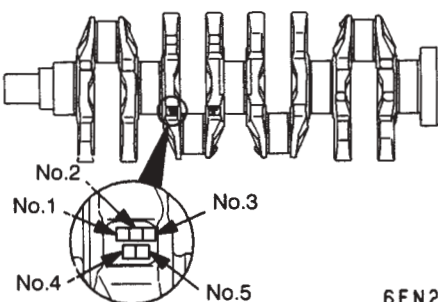
Removal and Installation



Removal Procedure

- | | |
|------------------------------|------------------------------------|
| 1. Flywheel bolt | ▶ A ◀ 9. Crankshaft bearing lower |
| 2. Flywheel | 10. Crankshaft |
| 3. Rear plate | ▶ A ◀ 11. Crankshaft bearing upper |
| 4. Bell housing cover | ▶ *1 ◀ 12. Thrust bearing |
| ▶ *1 ◀ 5. Rear oil seal case | 13. Check valve |
| ▶ *1 ◀ 6. Rear oil seal | 14. Oil jet |
| ▶ *1 ◀ 7. Bearing cap bolt | 15. Cylinder block |
| ▶ *1 ◀ 8. Beam bearing cap | |

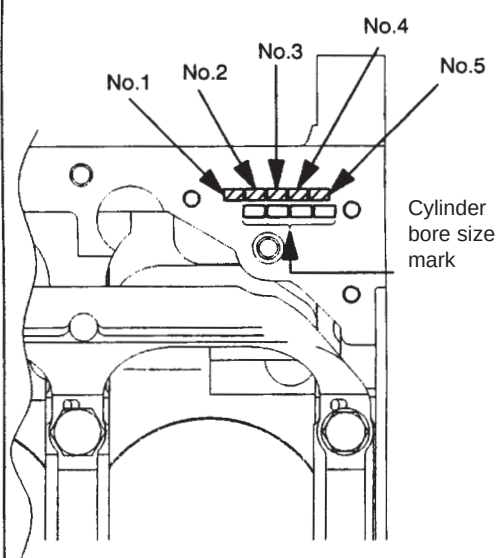
Position of crankshaft journal diameter identification marks



6EN2169

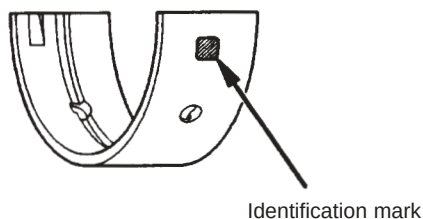
← Timing belt

Cylinder block bearing hole diameter identification mark

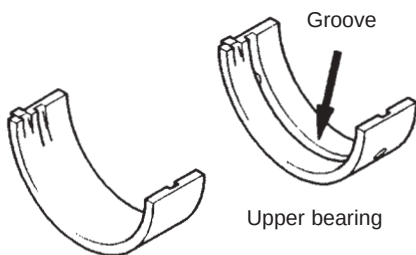


6EN1618

Position of crankshaft bearing size identification mark



6EN1096



Lower bearing

Upper bearing

6EN1558

Installation Service Point

► A ◀ Installation of crankshaft bearings

- Using the table below, select a bearing of the correct size corresponding to the diameter of the crankshaft journal.

(Selecting a bearing : Example)

If the identifier on the crankshaft journal is 0, and the identifier on the cylinder block bearing is 1, then a bearing with identification mark 1 should be chosen.

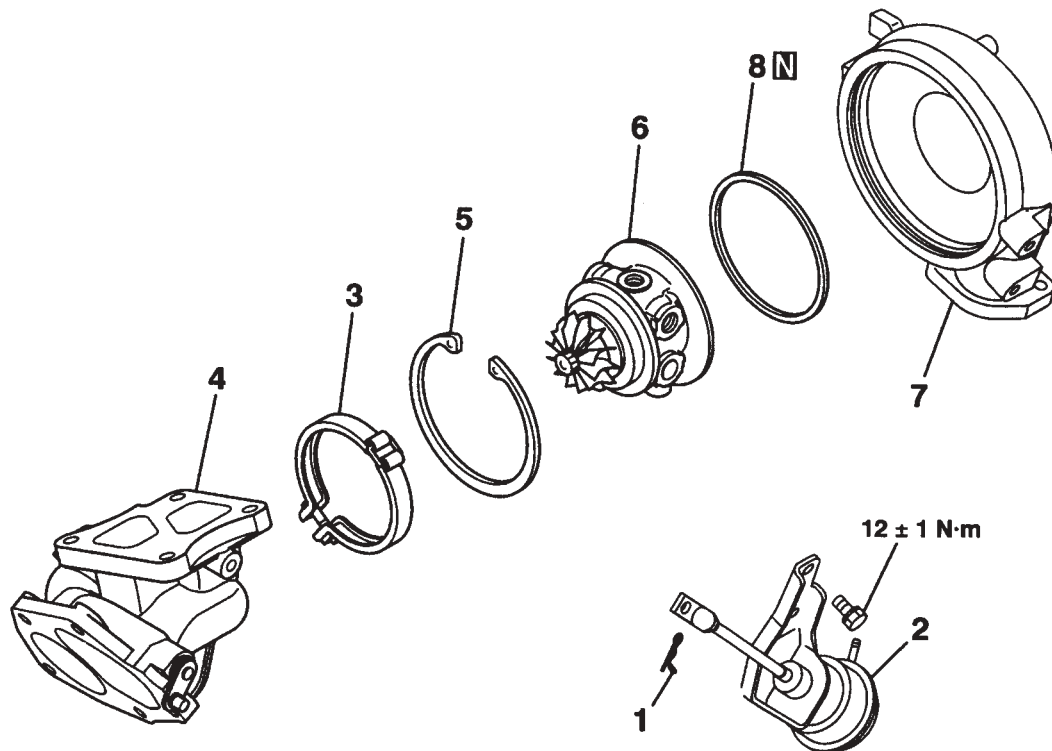
If the identifier on the crankshaft is difficult to make out, measure the diameter of the journal and choose the bearing that corresponds to the measured diameter.

Crankshaft journal diameter		Cylinder block bearing	Crankshaft bearing
Identification mark	Journal diameter (mm)		
0	56.994~57.000	0	0
		1	1
		2	2
1	56.988~56.994	0	0
		1	1
		2	2
2	56.982~56.988	0	0
		1	1
		2	2

- Install grooved bearing on cylinder block side.
- Install bearing without oil groove on bearing cap side.

Turbocharger

Disassembly and Reassembly



AK403845AB

Disassembly Procedure

1. Snap pin
2. Waste gate actuator
- ▶*1◀ 3. Cap ring
- ▶*1◀ 4. Turbine housing
- ◀*1▶▶*1◀ 5. Snap ring
- ◀*1▶▶*1◀ 6. Cartridge assembly
7. Compressor cover
- ▶*1◀ 8. O ring